THE INDIAN FORESTER

Founded in 1875

Volume 114 DECEMBER 1988 No. 12

Tleegram Indian Forester Telephone : 27021/264

INDIAN FORESTER

(A Monthly Journal of Forestry and Forestry Research)

BOARD OF MANAGEMENT

Chairman—A.G. OKA, I.F.S., Inspector General of Forests, Govt. of India, New Delhi.

Vice Chairman—R.V. SINGH, I.F.S., Director General, Indian Council of Forestry Research & Education, Dehra Dun.

MEMBERS

Andamans: S.S. CHANA, I.F.S., Andhra Pradesh: K.V.S. BABU, I.F.S.; Arunachal Pradesh: P.P. MALHOTRA, I.F.S. Assam: S. DEB ROY, I.F.S.; Bihar: R.P. SINGH, I.F.S.; Dadar & Nagarhaveli: H C. DHAWAN, I F S.; Goa: PANDEY B.P. SINHA, I.F.S.; Gujarat: M.N. VAISHNAV, I.F.S; Haryana: GURNAM SINGH, I.F.S.; Himachal Pradesh: A.K. MUKERJEE, I.F.S.; Jammu & Kashmir: EJAZ AHMED MALIK I.F.S.: Karnataka: S. SHYAM SUNDER, I.F.S.; Kerala: M. SIVARAJAN, I.F.S; Maharashtra: U.B. PATIL, I.F.S.; Madhya Pradesh: V.B. SAHARIA, I.F.S.; Manipur: B.S.K. SARMA, I.F.S.; Meghalaya: A. WAHLANG, I.F.S.; Mizoram: O N. KAUL, I.F.S.; Nagaland: K.I AO, I.F.S.; Orissa: S.C. PADHI, I.F.S.; Punjab: S.K. KAPUR, I.F.S.; Rajasthan: K.K. KOTIA, I.F.S.: Sikkim: P.K. BASNETT, I.F.S.; Tamil Nadu: S. JOHN JOSEPH, I.F.S.; Tripura: M. SARKAR, I.F.S.: Uttar Pradesh R.D. GUPTA, I.F.S., West Bengal: B.K. BARDHAN ROY, I.F.S.

RULES OF MANAGEMENT

1. *Pre-payable Annual Subscription* :—

INDIA	FOREIGN	SINGLE COPY (Current and Back issue)
(Inclusive of Postage)		(Exclusive of Postage)
Rs. 150.00	$ 80.00 (By Sea Mail)	India Rs. 20.00, Foreign $ 8.00
	$ 140.00 (By Air Mail)	

Note :—Subscriptions are generally booked for a Calendar Year (JANUARY-DECEMBER), and/or from JULY-JUNE. Copies for intermediate months (of current issue) can, however, be supplied on payment, if available.

2. *Concessional Rates of Annual Subscription* (Applicable to Serving Forest Officers & Forest Scientists in Government Institutes and Government Departments in India only) :—

Those drawing a Salary of less than Rs. 2000.00 p.m. ... ... Rs. 75.00 per Annum

3. *Life Subscription* :—Forest Officers, on retirement from service in India, can obtain copies of the *Indian Forester* for life by one Single Payment of Rs. 500.00 or its equivalent. A life Subscriber will be enrolled as such hand entitled to receive copies of the Journal from the date of receipt of the full amount of his Life subscription. Request for back numbers of the Journal will not be entertained. These can, however be supplied if available, on payment fixed for back numbers.

4. *Advertisement Tariff* :—(The rates are exclusive of blocks, etc. and are liable to change WITHOUT NOTICE). All Advertisement Matter is strictly subject to the approval of the Management.

N.B.—The Table below shows Contract Rates for and over SIX and TWELVE Insertions respectively to be consumed in one YEAR or THREE Insertions booked at a time and printed in three successive Issue of the Journal. The figures in the right-hand column denote Charges for Casual and Single Insertions.

Space	12 Insertions	6 Insertions	3 Insertions	Casual (Per Insertion)
Full Page	Rs. 3000.00	Rs. 1600.00	Rs. 900.00	Rs. 300.00
Half Page	Rs. 1800.00	Rs. 1000.00	Rs. 600.00	Rs. 200.00
Quarter Page	Rs. 1200.00	Rs. 750.00	Rs. 450.00	Rs. 160.00
2.5 cm Across Page	Rs. 1000.00	Rs. 600.00	Rs. 400.00	Rs. 140.00

Note :—(1) Extra charges over the above Rates for (*a*) Multi-Colour Insertions (up to four colour only) 75% (*b*) Double-colour (Red only or Red and Black)—25%; (*c*) Advertisement on Art Paper—25%
(2) Half-tone and Line Blocks, Stereos, and Matrices accepted. Blocks of all description and/or other Advertisements material are to be supplied by the Advertising parties themselves.
(3) screen used for Advertisements : 80—100.
(4) Only one *Voucher Copy* will be supplied Overall Size : 24 cm × 18.5 cm: Printing Size (Full-page) 20 cm × 15 cm.

Important—(*a*) Advertisement charges are strictly Payable in advance preferably by a bank Draft on State Bank of India, Dehra Dun. U.P. (India); and drawn in favour of the Business Manager *Indian Forester* (*b*), The Advertisement matter, which should be TYPEWRITTEN in BLOCK LETTERS and should be sent in DUPLICATE. For further particulars and terms of business please apply to the Business Manager, *Indian Forester*.

(5) Correspondence concerning subscriptions, etc., should be addressed to the Business Manager *Indian Forester*, P.O. New Forest, Dehra Dun (India). All payments on account of Subscriptions and Advertisement, etc., must, however, be made in the name of the Business Manager, *Indian Forester* and Cheques, etc., drawn in his favour.

(6) All complaints regarding delay in receipt or non-delivery of a copy or copies of the *Indian Forester* should be made WITHIN 30 DAYS from the due date of publication of an issue which is 1st of each month to the Business Manager, *Indian Forester*, P O. New Forest, Dehra Dun. Efforts will be made to supply duplicate copy or copies of the missing number. *free of cost*, provided a complaint is received in time, and on payment if a complaint as received after 30 days subject to the availability of a copy or copies in stock in their case.

(7) In case of dispute, Dehra Dun U P. (India), shall be the place of jurisdiction.

IMPORTANT NOTICE

With the pressing demands and in the interest of our readers, it has been decided to bring out the issues of the *Indian Forester* from January 1989 with laminated coloured cover page. The inner text will also be printed on superior quality paper which will improve the get-up of this ancient journal which is serving the cause of scientific forestry since 1875 without interruption.

Consequent with the above changes, the cost of production will increase and to meet the increased cost it has become necessary to revise the subscription rates per annum with effect from Ist January, 1989 as given below. We are confident that the necessity for this step will be appreciated by our subscribers and they will continue to give their whole hearted co-operation and support to the journal.

New Subscription Rates

India

Rs. 250.00

Foreign

$ 100.00 (By Sea Mail)

$ 150.00 (By Air Mail)

Concessional Rates

(Applicable to serving forest officers and forest scientists in Govt. Institutes and Govt. Departments in India)

(1) Those drawing salary less than Rs. 2,000/- : Rs. 125.00.

VOLUME 114 NUMBER 12

THE INDIAN FORESTER

DECEMBER, 1988

EUCALYPTUS EXPERIMENT—BRAZIL

S. SHYAM SUNDER*

Introduction

Brazil is not all Amazon valley. The country is 2 6 times the size of India and there are areas where the nearest native timber source is over 3000 km away. This had prompted the introduction of *Eucalyptus* about 150 years ago to Brazil, and its intensive cultivation trials since the beginning of this century covering 200 species/provenances. However, it was in 1966 that the tree planting programme, mainly with *Eucalyptus*, received a tremendous boost in Brazil with the new tax incentive law. The new law provided for a deduction of money upto 50% of tax due in case of companies and 50% of gross income in case of individuals investing privately or in companies, in forestry programmes.

Brazil has over 180 million hectares covered by savannas–with low native fertility especially of phosphorus. Eucalypts appeared to hint at a reasonable potential in such areas though the experience of over 70 years with low productivity, high heterogeneity, pests and diseases had not proved it Brazil also had its share of critics of this species, as in our country. The new tax law, on the one hand prompted the creation of several forestry enterprises and on the other saw to the commencement of intensive genetic research through Institutions and Universities Aracruz Florestal, a pulp company based on its own plantation, visited by me and Goankar was one such with its own Research and Development Centre. There are several others in Brazil.

The developments since 1966 have been phenomenal. The export of processed wood products from Brazil doubled to $ 900 million by 1984, in 10 years. It provided 15.6 million tons of wood charcoal as iron ore reducing agent. *Eucalyptus* also now constitutes 20% of the primary energy production. In the field of pulp there was a jump of 450% between 1970 and 1983, to produce 3.2 million tons. With the world consumption of pulp increasing by 3 to 4 million tons per annum, Brazil is banking on a perma-

* Principal Chief Conservator of Forests, Karnataka State, Bangalore.

nent increasing world market for this produce. The cost of wood to produce a ton of pulp compared with some of the other pulp producing countries is as follows :

	US dollars/ton
Finland	155
Sweden	145
Canada (East)	92
U.S.A (South)	85
Portugal	65
Brazil	55

(In India, except where the supplies are made on a subsidised basis, the average cost at the mill site varies from 175 to 200 dollars).

If the area of *Eucalyptus* plantation in Brazil was 0.5 million hectares in 1966, before the tax incentive law, today it has crossed five million hectares.

Aracruz Florestal Experience

The climatic and soil conditions at Aracruz are generally better than in the main savanna belt. The tree growth however is mostly degraded resembling a savanna except in a few blocks where it is closed, though of secondary origin. Trees in these blocks are about 15 to 20 m tall and the under cover is dense. Such forests are preserved and they have been designated as sanctuaries, recognised as such by the Forest department. These blocks of protected forests cover 28,000 hectares out of a total area of 100,000 hectares belonging to Aracruz Florestal.

The property of Aracruz Florestal is in two localities, on the eastern coast of Brazil, north of Rio de Janeiro. The latitude of Aracruz is 19°48′ south. The altitudinal variation is between 5 and 50 m. The average rainfall is 1360 mm generally spread over 9 to 10 months in the year. The average of maximum temperature is 29.3°C, average of minimum temperature 19.1°C. The relative humidity is fairly high at 80%.

The Aracruz project was started in 1967 with planting of *Eucalyptus*, which today covers 72,000 hectares. The pulp mill was set up in 1978 with a capacity of 400,000 tons of bleached pulp. With the improvement in yield by 1984 the production had crossed 4,56,000 tons and presently the mill's expansion programme, on hand, will provide for 800,000 tons of bleached pulp without any increase in the plantation area.

To begin with *Eucalyptus* seeds from available sources in Brazil were availed of. A little later seeds from Republic of South Africa and Zimbabwe were imported obtaining better results. In 1973 pure genetical seeds were collected in Australia and in Timore islands, Indonesia, from regions having similar climate. Simultaneously *Eucalyptus* root cutting technology was developed with a target of propagating plus trees. The mother trees were selected among company's plantation seeking the best "site × clone" interaction. The main specie is *E. grandis* and interspecific hybrid like *E. grandis* × *E. urophylla*. In selecting the mother trees it was not merely the rate of growth but the maximum desirable characteristics with the end purpose, production of bleached pulp, in aim. The factors taken into consideration were :

(1) The selected trees must have a volume of more than 1 m^3 including bark at the 7th year.

(2) It should be immune to disease and insect attack. It would be interesting to note here that in the Aracruz region fungus *Corticium* is not come across. Instead canker disease caused by fungus *Cryphonectria cubensis* is common. Further damage from leaf cutting ants is also an important factor.

(3) It should be straight and have small limb with self pruning capacity which avoids tension in the wood.

(4) Bark should be smooth.

(5) The crown should be well shaped having a large leaf volume.

(6) Such trees on being felled are further analysed for bark percentage, to be less than 10%.

(7) The basic density of wood should be between 500 and 600 kg/m^3. The wood is also analysed for length of fibres, wall thickness, specific gravity and cellulose yield.

(8) It should have high coppicing ability and the cuttings should root easily.

At the next stage the rooted cuttings are tested for their genetic suitability. The ramets are planted in different types of soil come across on the lands belonging to the company to test their growth potential, resistance to pests, wood properties and adaptation to the soils.

Assessment in clonal test areas is made after half rotation (3 to 4 years) and the best clones are propagated for multiplication. An area of 36,000 ha of *Eucalyptus* plantation raised from pure genetical seeds had provided 5,000 plus trees, narrowed down to 150 clones of which 31 of the very best are now used for the plantation programme. The earlier plantations from genetical seeds are now being replanted with these root cuttings This is done by ripping the soil between the lines, the soil obtained being heaped (mechanically) to form a ridge in the line covering the *Eucalyptus* stumps of the earlier trees, which kills the stumps. The new planting is taken up in the furrows.

The yield of *Eucalyptus* in the Aracruz plantations has increased from 15 cm/hectare/year to 100 cm/hectare/year. According to Yara Ikemori, geneticisist, this is not the ultimate. We cannot of course, considering our rain fall pattern expect yields of 100 cm/hectare/year, per se. What is interesting is the fact that given the same site factors it has been possible to increase the yield with 25 years research, by around 700%. In Brazil with the significance and importance of this factor in consideration I have furnished below a very detailed account of the production of vegetative propagules, site preparation and plantation management practices. This is with the hope that every State which has tried *Eucalyptus* so far and has its share of wastelands can, with a small proportion of the investment now being made in the plantation programme, initiate works in line with what has been done in Aracruz. We can take up trials with seeds obtained from suitable provenances of species occurring in similar climatic zones as one item and the other, identify the plus trees in the existing plantations to provide the clones for extension by vegetative propagation.

The selected plus trees are cut slightly above the ground level at apporximately 12 cm height. The age of the shoots has a

bearing on the rooting capacity. At Aracruz the harvesting of the shoots is taken up between 45 and 55 days after the tree has been cut. The period may vary depending on our site and climatic factors, but what is to be noted is that we should be able to secure the maximum number of cuttings but before the cuttings get to be too lignified. One or two vigorous shoots, properly located, are left behind in the stump to develop into a new tree The sprouts are harvested with pruning shears and are placed in a bucket having water deep enough to cover the base of the cuttings. These are transported to the nursery in a covered truck, protecting it from direct sun light, wind and excessive heat. The buckets are placed under shade, at the nursery site, care being taken to see that the bucket always has water at the base and the cuttings do not wilt.

The shoots are collected, prepared and planted in the nursery the same day. They are severed with shears into individual cuttings such that each one of these has one or two pairs of leaves, depending on the internode length The length of the cuttings vary from 10 to 15 cms. Leafless cuttings, cuttings obtained from twigs and coppice arising at points distant from the ground do not root. If a cutting has twigs these are cut off close to the leaf axil. The leaf area of the cutting is reduced to less than half the original leaf size, both to reduce transpiration and to avoid the large heavy leaves from falling and overlapping. The bases of the prepared cuttings are treated with Benlate fungicide to prevent rotting. The solution is applied at concentration of 200 ppm by immersing the base of the cutting in the solution for 15 to 30 minutes. The base, to a distance of 2 cms is then treated with Indole-butyric acid, diluted with talcum powder. The concentration of Indole-butyric acid is 6000 ppm. As the base of the cutting is damp due to Benlate treatment, the hormone talcum mixture adheres to it readily. Excess mixture is removed by tapping the cutting lightly. In the initial years the planting was in plastic bags but now it is done in Polypropylene tubes in Polystyrene trays, developed in Hawaii by Gerald Walters. The growing medium in the tubes is vermiculite.

Tubes and Trays

The containers used at Aracruz and in most of the other enterprises, are conical polypropylene tubes stuck in o a tray made of Polystyrene, each tray holding 96 tubes. A tray with 96 seedlings weighs only 5 kgs.

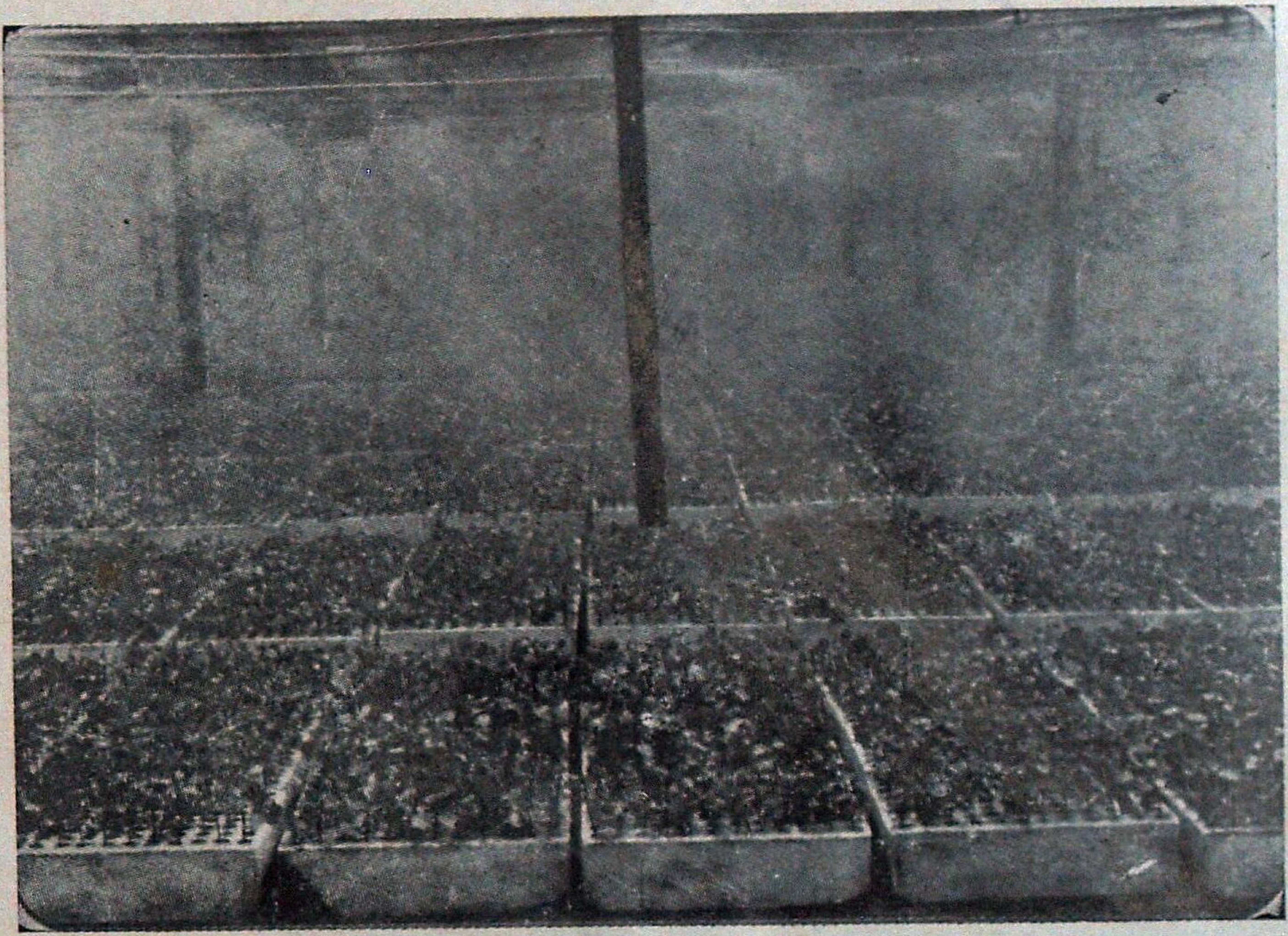
The plastic tube is 3 cms in diameter at the top, 12 cms long and has a one cm hole in the base. There are 4 internal ribs that head the roots towards the bottom, preventing spiral growth.

The tray is 16 cms high so that tubes are suspended 4 cms above the ground. The distance between the tubes, centre to centre is 5 cms.

Growing medium

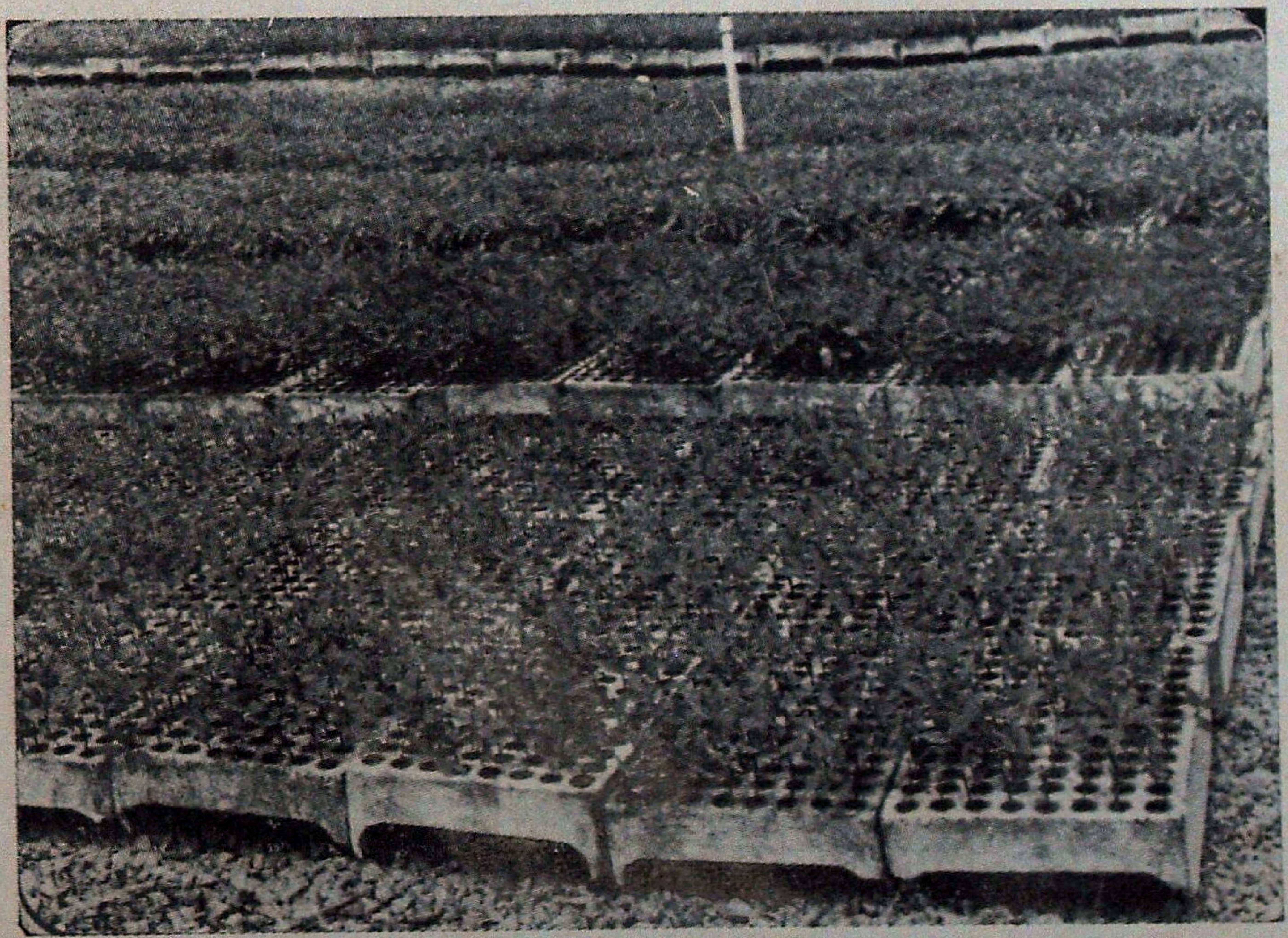
Trials had shown that the growing medium should have good ability to retain humidity for draining surplus water, for aeration, and should be light to facilitate handling. Vermiculite answers the requirements. Mediums containing organic matter on the one hand are likely to cause rotting of the cuttings even when treated with

Plate 1



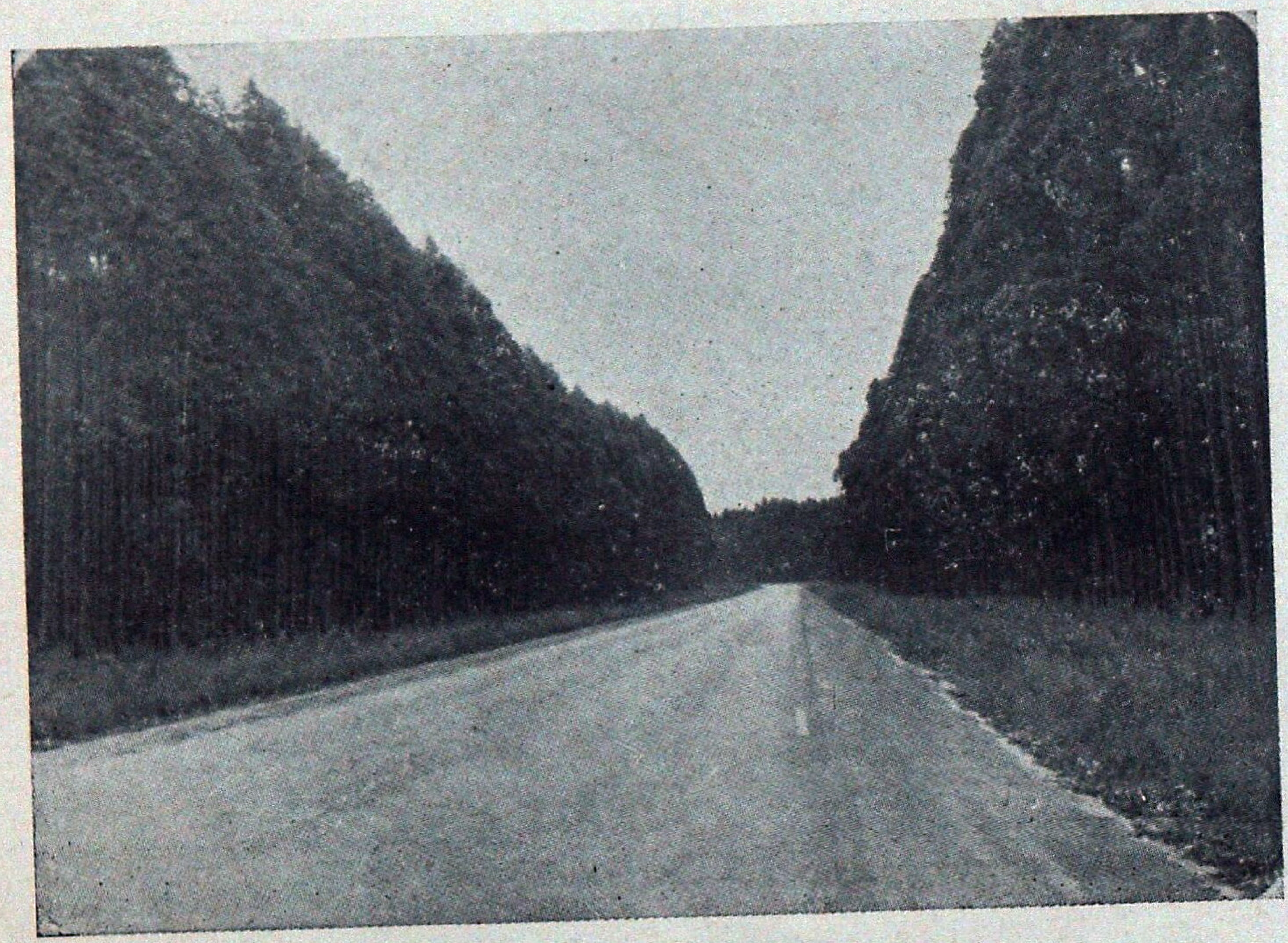
Green House for the rooting of cuttings; mist-spray in operation.

Plate 2



The rooted cuttings kept in open for hardening.

Plate 3



Three year old *Eucalyptus grandis* plantation

Plate 4

Leaf litter in the *Eucalyptus* plantation; while there are no weeds the entire ground surface is covered with leaf litter.

fungicide and on the other have not given good rooting results.

Planting in Tubes

Planting of the cutting in the tube is in a hole made in the centre of the tube. The hole is slightly larger than the diameter of the cutting and is around 4 cm deep. The base of the cutting is introduced into the hole and growing medium is pressed with the fingers against the cutting so as to secure it in the vertical position.

Shade House

The cuttings are transferred the same day to the shade house and kept there till they develop a good root system, normally a period of 5 to 6 weeks. The shade house is built with steel wires stretched over round wooden stakes treated to avoid rooting. It is 2.20 m high. Shading is achieved by the use of nylon or polythene net resting on the steel wires. Depending on the light intensity at the sit and site variation from season to season nets providing 40% to 70% shade are used. The same kind of nets are used for the sides of the shade house to protect the propagules from wind.

Watering is done by intermittent mist propagation controlled by auto equipment if electricity is available. It can also be controlled by hand operated epuipment if there is no electricity. The mist spray units are located over spaces between the beds so that dripping will not affect the cuttings. Irrigation inside the shade house is intended to keep the leaves of the cuttings damp all the time until the root system forms. If the leaf surface gets to be dry, the cuttings will not form roots.

Fertilisation

In the 4th week the seedlings receive fertilisation at 3 kgs of NPK (5 : 17 : 3) dissolved in 100 Ltr. of water, for 15,000 cuttings.

Hardening of the cuttings

The cuttings are removed from the shade house and laid out in an open area in the 6th week to develop and harden off. At this stage another treatment with the same dosage of fertiliser, as before, is provided.

Planting

At the beginning of 9th week selection takes place and consists of discarding of dead cuttings and separating live cuttings by two different sizes. The larger seedlings are used for planting in the field at the end of 10th week while the smaller cuttings are again fertilised when they get to be ready for planting by the end of 12th week.

In each cutting only one shoot is retained and the rest are removed. The original leaves are also clipped and eliminated. The root-lets that have grown beyond the hole in the container base are cut off. The seedlings obtained from rooted cuttings are about 20 cm tall at the time of planting.

Site preparation

In the case of areas taken up for planting for first time all rank growth is removed. This is followed by ploughing and discing the soil. As the soil in Aracruz is poor in phosphorus, 500 kgs of rock phosphate is added per hectare. In case of older *Eucalyptus* plantations taken up for fresh planting with rooted cuttings the same dosage of phosphate fertilizer is added. In the older plantations of Aracruz it is

seen that 7 tons of dry matter in the form of leaves, fruits, twigs and bark are added to the soil every year from about fourth year onwards This material plus the phosphate fertiliser assure that the nutrient and the physical properties of the soil are properly preserved. Alignment and planting are taken up thereafter. The spacing currently employed is 3 m × 3 m. In the experimental plots it has been made out that an espacement of 4 m × 3 m is preferable and the change over to this increased espacement is now proposed. With the well spread out rain fall in the Aracruz belt planting is a continuous process. If during the day of planting and immediately thereafter there is no rain, a light irrigation to each individual plant is provided. Planting is by hand with precaution to see that the vermiculite medium is not disturbed. A survival rate of 99% is expected and secured.

The planted area is kept clean of weeds as the growth of *Eucalyptus* has been found to be inversely proportional to the presence of weeds.

The company is aware of the risk of pest or disease with a small number of clones availed off as planting material. The research team is confident of tackling any of these, mainly through biological media.

It was the thoughtful suggestion of Burely, Head, Forestry, Oxford University and his close contacts with Aracruz Florestal that made us welcome at Aracruz. Ron Kemp of Overseas Development Administration, Great Britain, made the trip feasible. Yara Ikemori and her colleagues at Aracruz made the trip worthwhile, more than worthwhile. I am gratefull to all of them and in particular to Yara who took us round to the different parts of the nursery and the various plantations, explaining in detail each feature come across. She made available the literature at Aracruz based on research, costing this company more than three million dollars per annum. She was convinced that India with its vast population depending on firewood as fuel and the magnitude of the degraded areas calling for attention, was capable of meeting its challenges provided we backed our efforts with research. When I complimented the progress achieved by the research team in increasing the yield by 700%, one of the researchers expressed that this was the beginning. What is tapped of the ultimate energy source, sun light, is still negligible.

SUMMARY

***Eucalyptus* was introduced to Brazil about 150 years ago but planting of this species received tremendous boost in 1966. This sudden change in planting programme took place due to tax incentives and development of technology for rooted cuttings from the clones. The experiment on production of vegetative propagules, site preparation and plantation management practices, conducted by the Aracruz Florestal have been described.**

ब्राजील में युकेलिप्टसों के परीक्षण

एस० श्यामसुन्दर

सारांश

युकेलिप्टस को ब्राजील में लगभग 150 वर्ष हुए प्रविष्ट किया गया परन्तु इस पादप जाति के लगाने का अत्यधिक उत्साह 1966 में प्राप्त हुआ । रोपण कार्यक्रम में यह एकाएक हुआ परिवर्तन करों में कमी का प्रोत्साहन दिए जाने तथा कतोनों से जड़ों वाली कलमें तैयार करने की प्रौद्योगिकी का विकास होने से आया। प्रस्तुत अभिपत्र मे एराक्रुज फलोरेस्टन में वर्धी प्रवर्धकों के उत्पादन, स्थल की तैयारी तथा रोपवन के प्रबन्ध की रीतियों पर किए गए संपरीक्षण का वर्णन दिया गया है ।

References

Campinhos, E. Jr. & Y.K. Ikemori (1983). Production of Vegetative propagules of *Eucalyptus* spp. by rooting of cuttings 2nd symposium on plantation forests in the neotropics–Its role as source of energy, IUFRO. Group Sl. 07.09, Viscosa, Feb. 6-13.

Campinhos, E. Jr. (1986). Forty productivities–Tropics–Aracruz Experiences.

Zobel, B., L.G. Brando, Y.K. Ikemori and E. Campinhos, Jr. (1984). The Marcus Wallenburg Prize Presentation papers. Aracruz Florestal, S.A. Rua, Prof. Lobo. 1128, 29190–Aracruz-ES, Brazil.

STUDIES ON THE EFFECT OF GROWTH HORMONES FOR VEGETATIVE PROPAGATION OF *WOODFORDIA FRUTICOSA* KURZ. BY ROOTING OF BRANCH CUTTINGS

V.K. BAHUGUNA, V.K. DHAWAN AND B.D. PANT
Division of Silviculture,
Forest Research Institute, Dehra Dun (India)

Introduction

Woodfordia fruticosa (Syn. *W. floribunda* Salish), commonly called "Dhaula" is an arborscent shrub (Family Lythraceae). It is extremely common and gregarious mostly in the degraded areas of Himalayas upto an elevation of 7500 ft. but is common upto 5500 ft. (Maithani, *et al*, 1986). Considering its importance as multipurpose species for reclamation of degraded areas of Himalayas, fuel and indigenous system of medicines, efforts are being made to develop regeneration techniques for this species. It has been found difficult to raise seedlings from the seeds.

Experiment on this species conducted in the Silviculture Branch indicated that though the seed germinated in different soil media in trays, the emerging seedlings died soon afterwards due to damping off. This investigation was therefore, taken up to find out the effects of growth hormones so that the propagation can be ensured. No work is reported on the growing techniques of this species so far.

Material and Methods

The experiment was initiated in summer (on 19.5.87) and continued during monsoon (upto 22.8.87). Cuttings of 18-20 cm long and 1.0 to 1.5 cm diameter size were treated with three hormones for different lengths of time. The treated cuttings were planted in the Polythene bags. The bottom portion upto 12 cm was put inside soil media. The soil media consisted of two parts of river bed sand and one part of soil. Cuttings were irrigated twice a day from the date of plantation till the closing of experiment. The meteorological data during the period of investigation is mentioned below :

Temperatures and humidity data during the course of study

Duration	Temp °C Max. (Av.)	Temp °C Min. (Av.)	Mean (Av.)	Relative humidity 0700 hrs. (Av.)	Relative humidity 1400 hrs. (Av.)
May 22nd to May 31st, 1987	35 73	17 07	26.40	61	37
June, 1987	36.1	20.1	27.40	78	47
July, 1987	33.7	22.9	27.7	87	64
Aug. 1st to Aug. 22nd. 1987	32.16	22.23	26.02	92	68.26

Source : Meteorological observatory, Forest Influence Branch, F.R.I., Dehra Dun.

Collection of cuttings

The total number of 468 cuttings were supplied by the Assistant Director (Hydrology), Srinagar, Garhwal. The collection of cuttings was done during the month of May, 1987.

Treatments : Cuttings were treated by the following hormones :

Name of the hormones	Duration treatment	Concen-trations
Indole Acetic Acid (IAA)	12 hrs. & 24 hrs.	100 ppm & 200 ppm
Indole butyric Acid (IBA)	,,	,,
Napthyle Acetic Acid (NAA)	,,	,,

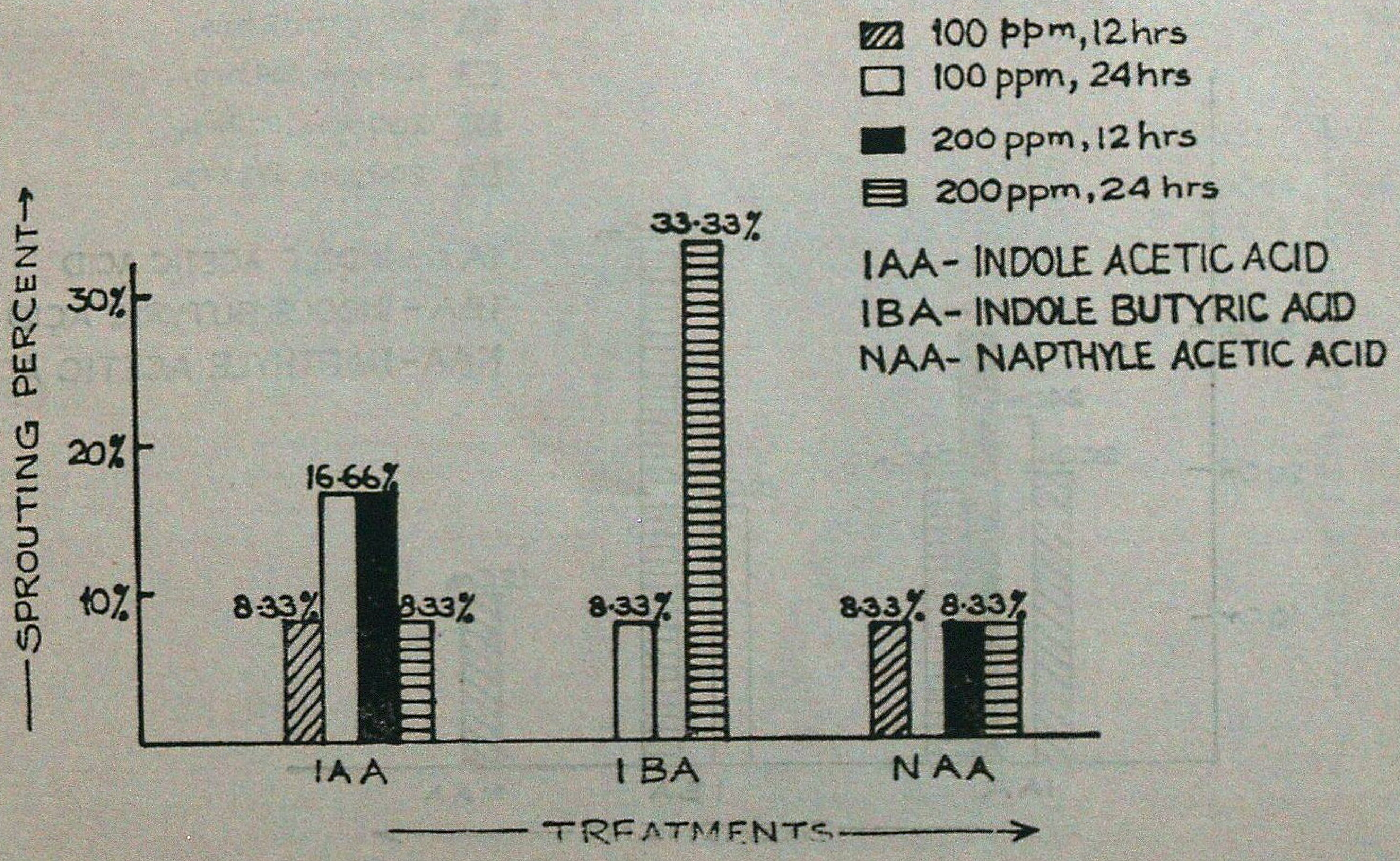
The above treatments were therefore, given in 13 combinations including one control and in each case 36 cuttings were tried. The bottom portion of each cutting was dipped in various combinations of treatments i.e. three hormones, two levels of concentration and two levels of duration.

Observations : Regular counts on number of cuttings sprouted were made after every fifteen days till the end of the experiment. Observations on survival of cuttings, number of roots per cutting and root length were collected at the end of the experiment.

Results and Discussions

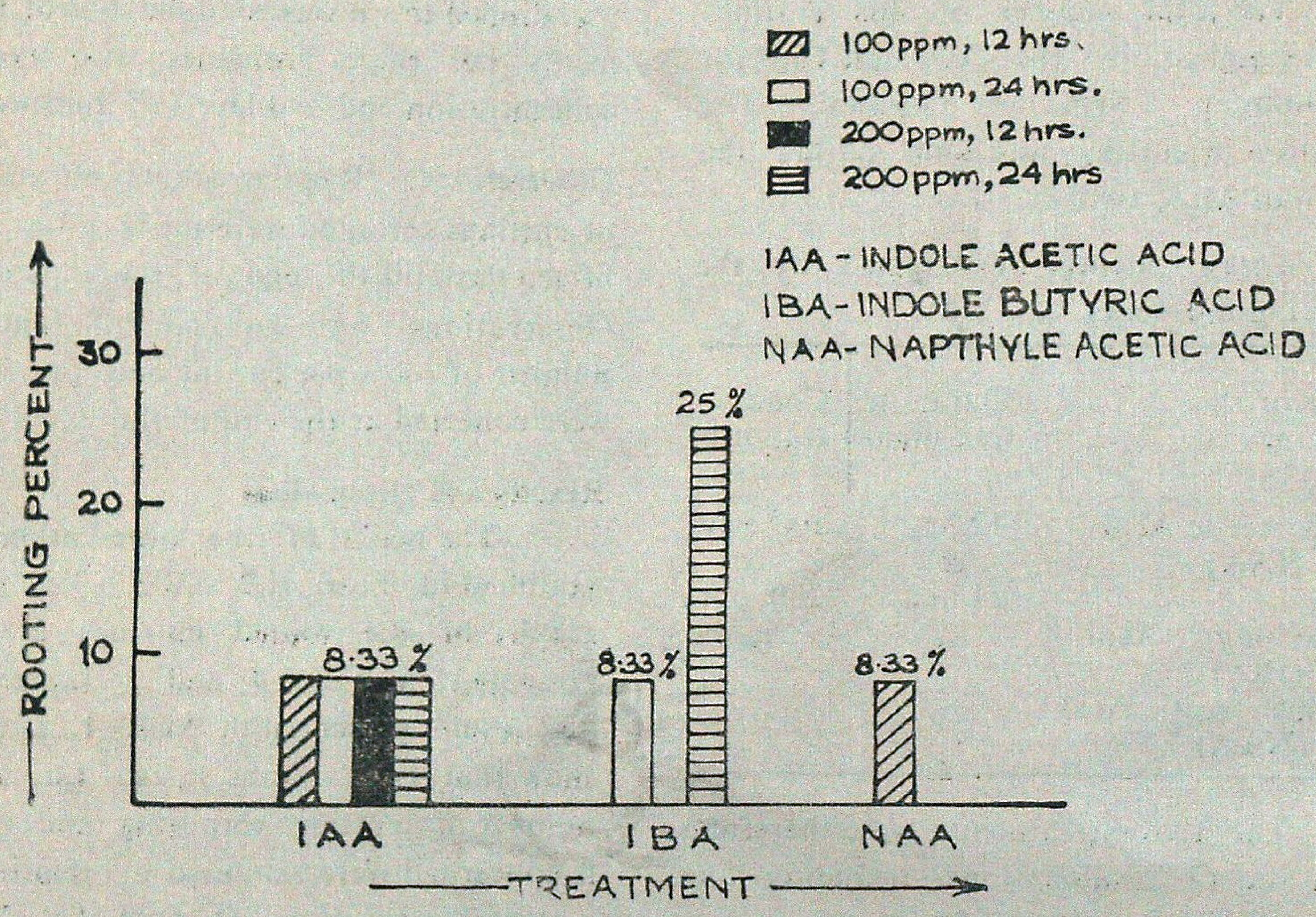
The result of the observations are exhibited in Figs. 1, 2 and 3. The photographs of the rooted cuttings are also presented in Figs. 4 and 5 respectively. The results presented in Figs. 1, 2 and 3 show that best result in so far as the number of cutting sprouting and rooting is concerned were exhibited by treating the cuttings with IBA-200 ppm for 24 hrs.

Fig. 1



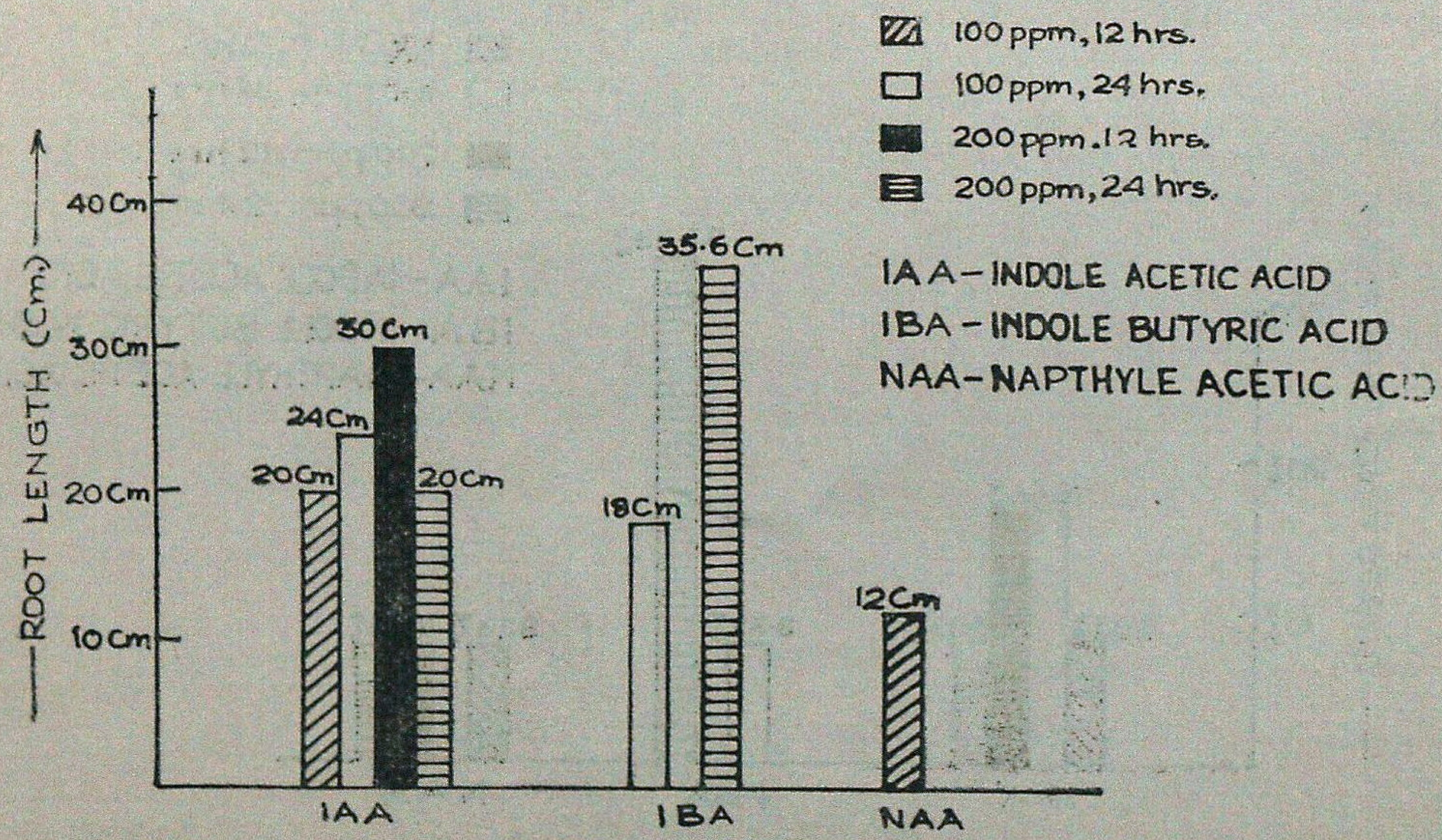
Bar diagramme indicating percentage of cuttings sprouted.

Fig. 2



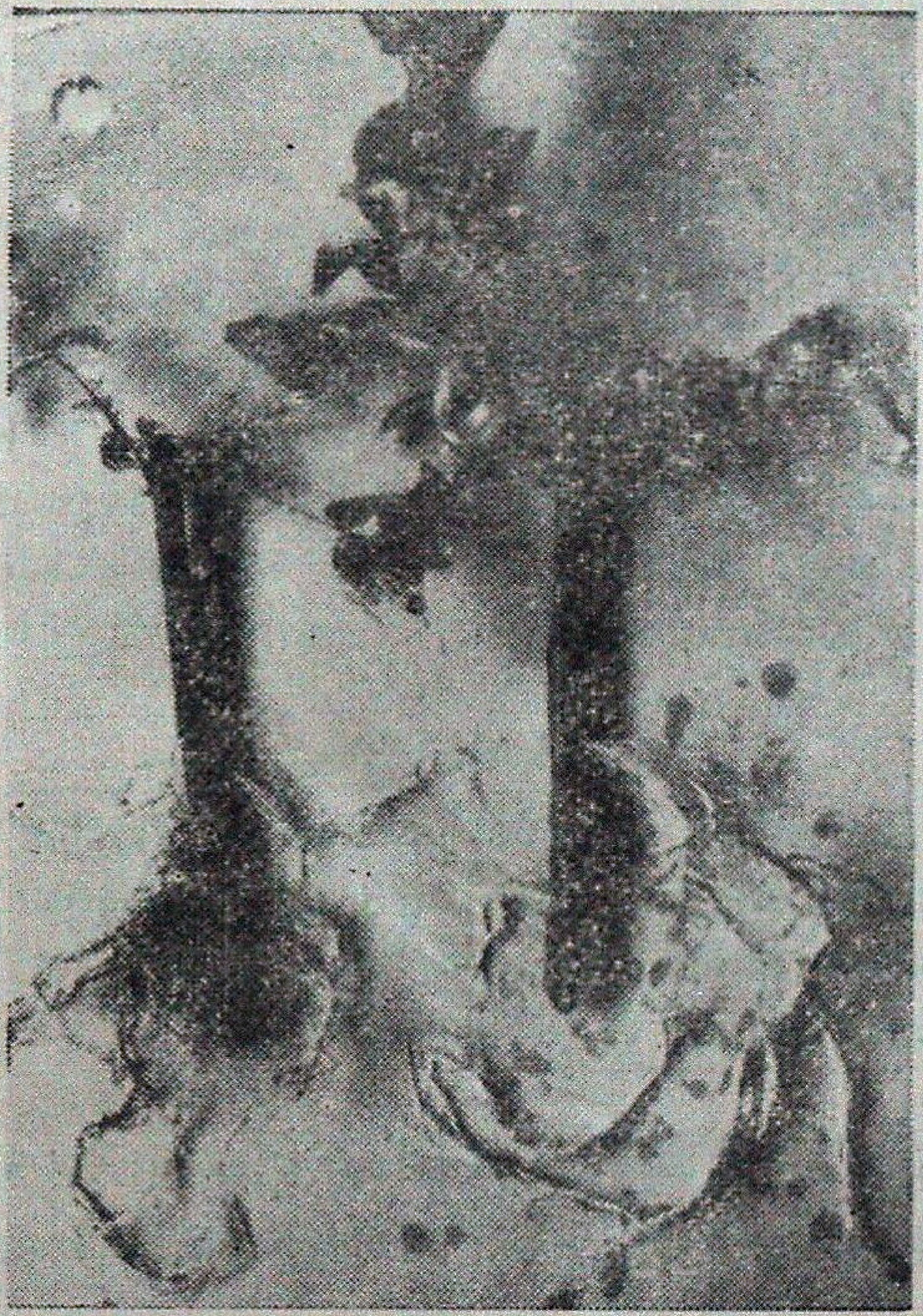
Bar diagramme showing percentage of rooted cuttings.

Fig. 3



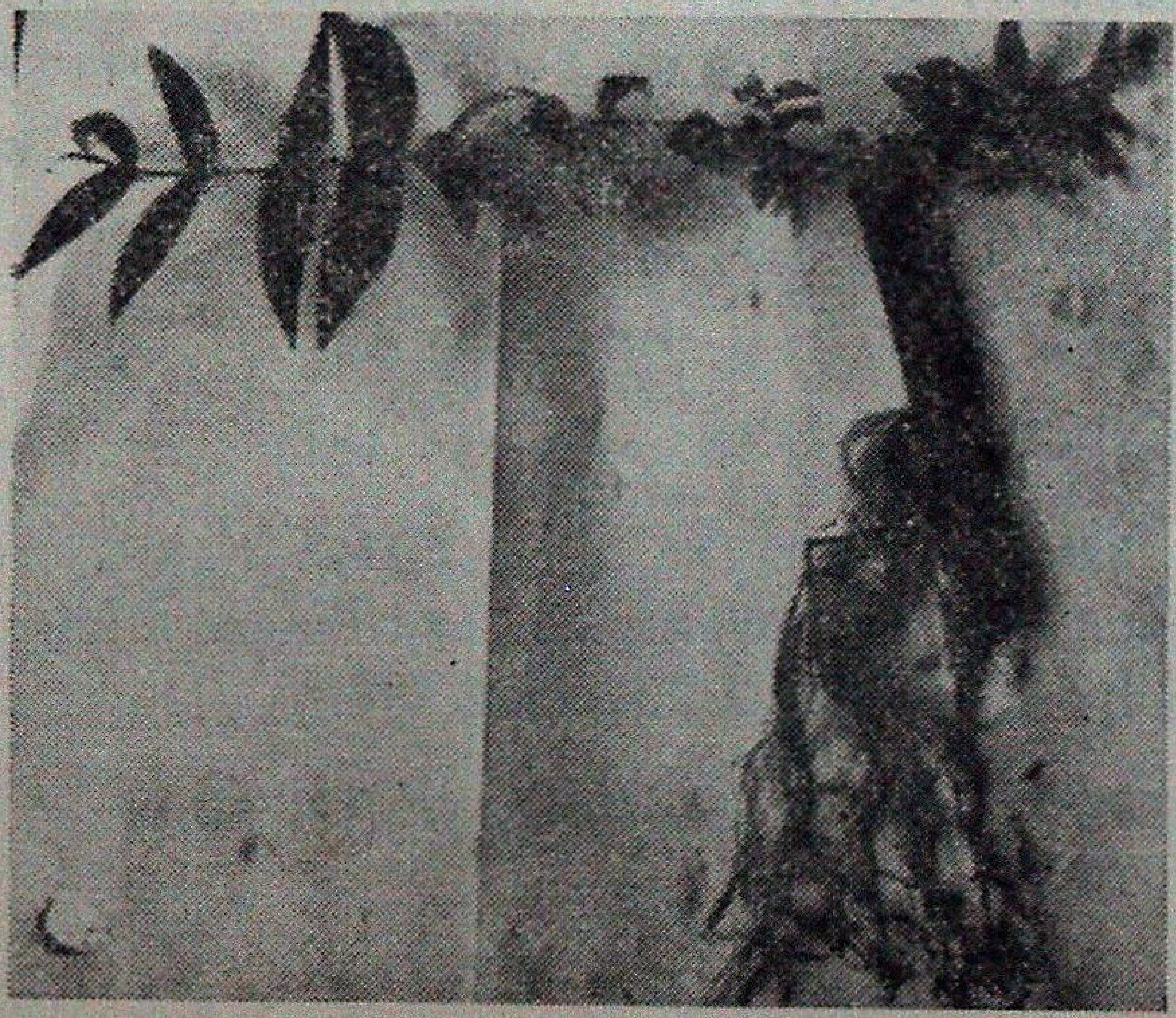
Bar diagramme showing average length of roots of cuttings.

Fig. 4



Rooting of cuttings treated with IBH–200 ppm for 24 hrs.

Fig. 5



Rooting of cuttings treated with IAA–200 ppm for 12 hrs.

This treatment resulted in 33.33% sprouting, 25% rooting and longest root length i.e. 35.6 cm, while 16.66% sprouting, 8.33% rooting and root length of 30 cm and 24 cm was observed when the cuttings treated with IAA-200 ppm for 12 hrs, and IAA-100 ppm, 24 hrs. The other treatments gave poor results.

The cuttings treated with IBA-200 ppm, 24 hrs, proved the best results in terms of average length of roots and average number of shoots also.

Conclusion

On the basis of this investigation, it is advisable to treat the branch cuttings of *Woodfordia fruticosa* with Indole Butyric Acid-200 ppm for 24 hrs. However, the investigation is required further detailed studies on vegetative propagation to find the effect of other physiological and physical factors during different seasons.

SUMMARY

In this communication results of an experiment to develop the vegetative propagation techniques through application of growth hormones are discussed. The results showed that the application of 200 ppm concentration of Indole Butyric Acid for 24 hrs. is best suitable for promoting rooting of branch cuttings of *Woodfordia fruticosa.*

शाखा कलमों में जड़े निकलवाकर वुडफोर्डिया फ्रुटिकोसा कुर्ज का वर्धी प्रवधन
करने के लिए उसमें वृद्धि हार्मोन प्रयोग करन के प्रभाव का अध्ययन

वी०के० बहुगुणा, वी०के० धवन व बी०डी० पन्त

सारांश

इस लेख में वृद्धि हार्मोन उपयोग करके वर्धी प्रवधंन प्रविधिया विकसित करने के सपरीक्षण के परिणाम विवेचित किए गए हैं। परिणामो से पता चला कि इण्डाल ब्यूटरिक अम्ल को 200 भाग प्रति 10 लाख भाग पानी में मिलाकर 24 घटे तक देना वुडफोर्डिया फ्रुटिकोसा की शाखाओं मे जड़े निकालना प्रेरित करने के लिए सर्वाधिक उपयुक्त रहता है।

References

Anon. (1976). *Wealth of India*, Vol. X., CSIR, New Delhi.

Maithani, G.P., V.K. Bahuguna and J.D.S. Negi (1986). Natural processes in the redeeming of Garhwal Himalayan Wastelands and Future Strategies for Reclamation–A case study. *Indian For.*, **112 (7) :** 608 615.

Troup, R.S. (1921). *The Silviculture of Indian Trees.* Vol. **II.**

MODIFIED VOLUME TABLE FOR EUCALYPTS IN HARYANA

J.K. RAWAT*

Introduction

Eucalypts have been planted profusely in India during the last ten years or so. Haryana, an agricultural state in the north, is in the forefront of this activity where *Eucalyptus* hybrid is now one of the most common species. Haryana Forest Department took up eucalypts plantations initially to meet the pulpwood requirement of a Paper Mill at Yamunanagar. Over the years, however, this species has also been found useful as sawn timber. Its fast and straight growing qualities and multiple uses have made eucalypts very popular with the farmers who now raise these trees on their fields as a commercial crop.

The growers usually sell their trees when these are mature or when they are in need of money. Most of them, however, do not know the physical and financial yields expected from their eucalypts trees. In this respect they are often assisted by the Forest Department. But the latter still employs the traditional volume table to estimate the volume of total wood produced by trees in various girth classes. This volume table not only gives a very crude estimate of physical output expected from a tree but also cannot be used to estimate its true financial worth.

In practice, eucalypts roundwood is classified into three major categories, namely timber, pulpwood and fuelwood. Since the market prices of these products vary greatly from one another, real worth of a tree or a plantation cannot be evaluated without knowing individually the volumes of timber, pulpwood and fuelwood obtained from it. Therefore, it becomes necessary to compile a 'modified volume table' that would indicate the optimal composition of output expected from a tree of a given size. The modified volume table, in addition to helping in the valuation of trees, can be used in making an assessment of efficiency of departmental harvesting operations.

The objective of this paper, therefore, is to construct a modified volume table for eucalypts in Haryana. Its application in valuation of trees and in determining the efficiency of departmental harvesting is demonstrated. Also, a methodology of estimating volumes of various tree components has been developed in this paper that can be employed in similar studies in other regions and/or for other species.

Methodology and Data

Volume data of eucalypts trees were collected from actual fellings of multiple-row strips and compact plantations at three different sites The sites were a canal strip (Bhalot Sub-Branch) in Sonepat district, a

* Head Division, Resource, Survey and Management, Forest Research Institute, Dehra Dun (India).

road strip (G.T. Road) in Karnal district and a compact forest area (Saraswati Plantations) in Kurukshetra district. A representative sample of trees was taken in each site for detailed measurement.

Girths (over bark) of trees and stems were measured. As is the practice followed in departmental harvesting operations in Haryana, the stems above 60 cm girth were treated as timber, logs between 60 and 20 cm girth as pulpwood and the remaining lops and tops as fuelwood. Timber portion of the stem was cut into convenient lengths between 1 and 3 meters. Girths of every piece were recorded at each end and in the middle. The total height of a tree was derived by adding lengths of logs from the tree and the stump height. Stacked volumes of pulpwood and fuelwood obtained from each tree were recorded. A total of 184 trees (49 in Sonepat, 35 in Karnal and 100 in Kurukshetra) were included in the sample.

The volume of timber logs were computed by using Newton's formula which is considered the most accurate for this purpose. According to it the volume of a log is given by the following equation :

(1) $V = (1/6) \times L \times (S_1 + 4\,S_m + S_2)$

were S_1, S_2 and S_m are sectional areas at thick and thin ends and at the middle of a log, respectively, and L is the length of the log.

Pulpwood and fuelwood are generally stocked and measured in stacks and, therefore, conversion factors were required to convert the stacked volume into solid volume These conversion factors have been found to vary from 0.30 for loosely packed stacks to 0.80 for tight or well packed stacks (Chaturvedi and Khanna, 1982). Taking into consideration the sizes of pieces included in pulpwood and fuelwood, the former is better stacked than the latter. For the present analysis, conservative values of 0.6 and 0.3 have been chosen as conversion factors for pulpwood and fuelwood, respectively.

Fuelwood is generally sold in quintals and, therefore, a relationship between its stacked volume and weight was needed. The stacks of green fuelwood obtained *in situ* from the trees were weighed. An average of 3.0 quintals per cubic meter of freshly stacked fuelwood was recorded.

Regression equation method was used to determine the desired volume table. Arithmetical relationships of total solid volume of tree over bark (VOB) and timber volume over bark (TOB) with girth over-bark at breast height (G) were established. Regression method was also used to estimate the stacked volumes of pulpwood (PW) produced from a tree, while the corresponding volume of fuelwood (FW) was estimated as a residual after subtracting TOB and PW from VOB.

Analysis and Results

A substantial work has been done in the field of developing models for volume estimation using regression equation method (Chaturvedi and Khanna, 1982). The models given below have already been developed for eucalypts (Chaturvedi, 1973). These were found most satisfactory in the present case also and have been used here for preparing the desired volume table :

(2) $\sqrt{VOB} = a + bG$ and $\sqrt{TOB} = a + bG$

where a and b are regression constant and coefficient, respectively.

The corresponding equations obtained from the data (184 observations) are given below :

(3) $\sqrt{VOB} = -0.186961 + 1.10826\ G$
(t = 42.0)
... (R^2=0.91)

(4) $\sqrt{TOB} = -0.377297 + 1.08272\ G$
(t = 35.0)
... (R^2=0.92)

The values in the parenthesis above give statistics 't' of the regression coefficient and the determination coefficient R^2 of the regression equation. The values of 't' much above 2.0 for 183 degrees of freedom indicate that the factor used in the model is highly significant. Also, the value of R^2 close to unity imply that the estimated equations fit the actual observations very well.

In practice we often need under bark volumes, especially for timber. For this purpose, bark volume data were also collected from the same three sites in Haryana. These have been analysed and discussed elsewhere (Rawat, 1989). That study shows that the bark constitutes 30.8, 17.2, 15.6, 15.1 and 15.0 percent of VOB for trees with girths of 30, 60, 90, 120 and 150 cm, respectively. In case of timber produced from a tree, the bark content varied from 21.9 to 20.2 per cent of TOB for trees with G = 75 cm and 150 cm, respectively. Using these results the underbark volumes, VUB and TUB can be estimated for the modified volume table.

Various models were tried to relate pulpwood quantities to tree girths. Satisfactory results were, however, obtained when instead of pulpwood quantities, the proportion of pulpwood in the non-timber output from a tree (i.e., VOB–TOB) was related to G through a simple linear model. The actual regression equation obtained is given below :

(5) $PWR = 1.021535 - 0.327406\ G$
(t = 9.9)
...(R^2 = 0.35)

where PWR is the fraction of pulpwood (solid) in the combined solid volumes of pulpwood and fuelwood of tree.

The modified volume table obtained by employing above equations is given in Table 1. Besides showing the total wood production (with and without bark), it gives the quantities of timber (solid volume, with and without bark), pulpwood (stacked volume) and fuelwood (green weight) expected from a tree of a given girth.

Table 1 shows that the timber content grows rapidly as the size of tree increases. It is also noticed that production of fuelwood increases faster than that of pulpwood as the tree girth increases. The existing volume table in Haryana gives average consolidated over bark volumes of 0.114 m^3, 0.312 m^3, 0.50 m^3 and 0.60 m^3 for girth classes 30-59 cm, 60-89 cm, 90-119 cm and 120-149 cm, respectively. Comparing with VOB above, we find that disparity in the two volume tables exists and it is very wide for bigger sized trees.

Applications

Using the modified volume table, stumpage value of an eucalypts tree of a given girth can be estimated for any given price scenario. As illustration, two different price combinations are considered and the corresponding estimated values of standing trees are given in Table 2. The timber price is taken on the basis of over bark volume.

Table 1

Modified Volume Table

Girth class (cm)	Average girth G (cm)	Structure and quantities of output					
		VOB (m^3)	VUB (m^3)	TOB (m^3)	TUB (m^3)	FW (m^3 stck)	FWWT (Qtl.)
	30	0.0212	0.0147	0 0	0 0	0 033	0 02
30—59	45	0.0972	0.0779	0.0	0 0	0 142	0.12
	60	0.2285	0.1892	0.0742	0.0616	0.212	0.27
60—89	75	0.4150	0.3482	0.1890	0.1476	0.292	0.51
	90	0.6569	0.5546	0.3566	0 2790	0 364	0 82
90—119	105	0.9540	0.8082	0.5769	0.4545	0.426	1 21
	120	1.3063	1.1089	0 8500	0.6734	0.478	1 69
120—149	135	1.7140	1.4564	1.1759	0.9354	0.520	2.26
	150	2.1769	1.8507	1.5545	1.2398	0.550	2.92

Table 2

Stumpage Value of Eucalypts Trees

Girth G (cm)	Price Scenario 1 PW=Rs. 100/st. m^3 FW=Rs. 20/Qtl.		Price Scenario 2 PW=Rs 150/st. m^3 FW=Rs. 30/Qtl	
	Timber price (Rs/m^3)	Tree value (Rs.)	Timber price (Rs./m^3)	Tree value (Rs.)
30	0	5.58	0	5.37
45	0	16.61	0	24.91
60	200	38 87	200	52.18
75	250	76 31	300	103 38
90	300	136.27	400	190.48
105	350	225.41	500	326.79
120	400	350.42	600	525 62
135	450	517.95	700	800.30
150	500	734.66	800	1164.11

Table 3

Efficiency of Harvesting Operations

Sl. No.	Production Divisions	Lot No.	No. of Trees	Expected Production		Actual Production	
				VOB (m^3)	TOB (m^3)	VOB (m^3	TOB (m^3)
1.	Karnal	447/85-86	2152	1293	702	1295	697
2.	Karnal	480/85-86	2359	1057	526	1072	530
3.	Y.nagar	249/84-85	2342	502	167	1130	646
4.	Y.nagar	284/84-85	4329	1744	834	1336	599
5.	K.kshtr	220/84-85	3442	1571	783	1323	367
6.	Y.nagar	213/83-84	3515	1009	414	1013	288
7.	K kshtr	23/85-86	4946	591	66	613	12
8.	K kshtr	22/85-86	2903	379	58	411	23

The first combination is at a relatively low price level and is meant for trees growing far from the market while the second one shows a higher price level for trees growing close to the consumption centres. Thus, a grower can know, for instance, that a standing tree of girth 75 cm should fetch him anywhere between Rs. 75 and Rs. 100, depending on the price level. He can also know that if that tree is allowed to grow to a girth of 90 cm, it can be sold for Rs. 135 to Rs. 200. Thus, coupled with the information of growth rate, he can make economic harvesting decisions.

This table indicates that the value of trees below 60 cm girth is very low. This is because these values are based on only three types of outputs, i.e., timber, pulpwood and fuelwood. The small sized trees are, however, more suitably utilized as ballis and poles, and if they are sold as such, they will fetch a higher price.

The second application of modified valume table is to assess the efficiency of harvesting operations. Official records of Forest Production Divisions of Karnal, Kurukshetra and Yamunanagar have been used to demonstrate this. The above table (Table 3) gives a sample of tree lots harvested by these divisions. The expected production of wood and timber, determined by using the modified volume table, has been compared with the actual production. Since timber is the most valuable output from a tree and can be estimated with a greater accuracy, its productivity has been used as a criterion to assess the efficiency of harvesting operations.

In the above table we find that the actual outputs from lots at serial No. 1 and 2 follow the expected outputs very closely. Often it happens that the measurements of trees are done several months (sometimes a couple of years) before the actual felling is done. In such cases the actual production would certainly be higher than the volumes estimated from the old measurements (marking lists). This is illustrated by the

lot at serial No. 3 where actual production in respect of both total wood and timber is substantially higher than the expected production. In contrast, the lots at serial No. 4 and 5 show that both the actual outputs are considerably lower than expected. Such cases indicate wastage and pilferage of produce. Inefficient and imperfect harvesting operations are clearly revealed in case of lots at serial No. 6, 7 and 8 where although actual volume production is somewhat higher than expected, the timber production is significantly low.

Conclusions

The accuracy of the modified volume table can be further improved by employing more felling data normally recorded by the Production Forest Divisions in the State. The tree samples employed in this analysis came only from the northern parts of Haryana. Observations from all other districts be taken and if variations in average output within different regions are not significant, a uniform volume table can be adopted for the whole state. Otherwise, preparation of regional volume tables may be advisable.

The results show that the variation in volume and value of a tree within the presently used girth class of 30 cm width is quite large. It may, therefore, be preferable to further divide each girth class into two sub-classes. Moreover, data should be collected for age, yield and diameter class distribution in plantations so that decisions on financial rotation, economic spacing and optimal utilization could be taken.

Acknowledgement

The author is indebted to Shri B.S. Raghav, H.F.S. of Haryana Forest Department for the collection of data.

SUMMARY

A modified volume table for *Eucalyptus* hybrid has been prepared using data from Haryana. This table gives the outputs of timber (stem above 60 cm girth), pulpwood (wood between 60 and 20 cm girth) and fuelwood (small wood below 20 cm girth) expected from a tree of a given girth (over bark at breast height). Its application in making financial valuation of trees and in assessing the efficiency of departmental harvesting operations is demonstrated.

हरियाणा में युकेलिप्टस की संशोधित आयतन सारणी

जे० के० रावत

सारांश

हरियाणा से प्राप्त हुए आंकड़ो के आधार पर युकेलिप्टस हाइब्रिड की संशोधित आयतन सारणी तैयार की गई है। यह सारणी किसी दी हुई गोलाई (वक्षोच्चता पर छाल के ऊपर) वाले वृक्ष की प्रकाष्ठ (60 सेमी० गोलाई से अधिक तने वाले) लुगदीकाष्ठ (60 और 20 सेमी० गोलाई के बीच का काष्ठ) और ईंधन काष्ठ (20 सेमी० गोलाई से कम का लघुकाष्ठ) बताती है। वृक्षों का वित्तीय मूल्यांकन तथा विभागीय कटाई कराने की दक्षता ज्ञात करने में इसे कैसे उपयोग किया जाए, यह भी दर्शाया गया है।

References

Chaturvedi, A.N. (1973). General standard volume table for *Eucalyptus* hybrid. *Indian For. Rec.* (New Series) Silviculture **12** (14), 9 pp.

Chrturvedi, A.N. and L.S. Khanna (1982) *Forest Mensuration.* International Book Distributers, Dehra Dun. 406 pp.

Rawat, J.K. (1989). Bark content of a Eucalypts tree. *Indian For.*, **115** (2).

INSECT PESTS OF LEGUMINOUS FOREST TREE SEED AND THEIR CONTROL

PRATAP SINGH AND R.S. BHANDARI

Forest Entomology Branch,

Forest Research Institute, Dehra Dun (India)

Introduction

Tree species of family Leguminosae form a major component of planting porgrammes in forestry, social forestry, farm forestry, wasteland development, stabilisation of sand dunes, reforestation and afforestation programmes. Beside providing green cover to the earth these species provide fuel and fodder for villagers and their live stock. All the leguminous species have the additional advantage of having the capability to fix the atmospheric nitrogen in the soil and thus enrich the earth with nitrogen fertilizers. The present interest in leguminous tree species stems from the fact that large scale planting programme of wastelands is envisaged in the country. Leguminous tree species being promising and useful resource for the future will be the natural choice for the afforestation programmes. Since large scale planting programmes require huge amount of nursery stock for which large quantities of sound, insect free seed is required, hence seed entomology have assumed great significance Insects particularly beetles of family Bruchidae are very serious pests of leguminous seed.

In India very little work has been done on the pests of pods/seeds of Leguminosae. Pruthy and Singh (1950) have given some information on the pests of grain legumes (pulses), Beeson (1941) have given brief information on the biology and ecology of pests of seeds of leguminous trees. Mathur *et al.* (1958) have listed the pests of tree legumes in Indian Forest Bulletin Ent. (N.S.) No. 223. In the paper presented in National Seminar on Forest Tree Seed, Singh & Bhandari (1986) and Sen-Sarma, *et al.* (1986) have discussed the important pests of forest tree species including legumes in field and during storage respectively. In the present paper an attempt has been made to discuss the seed entomology of tree legumes.

Biology of seed insects – some important considerations

A large number of insect species particularly those belonging to the orders Coleoptera and Lepidoptera, have been found to be associated with fruits (pods) and seeds of Leguminosae in the field. Some of these field pests are carried to the storage places. These insects are of two kinds, *i.e.*, (i) those adapted for life in seeds, and (ii) those that are general scavengers and are able to attack seeds, along with organic debris. The former group are called primary pests and the latter gro p secondary pests. Sometime secondary pests also cause

appreciable damage to leguminous seeds. The larvae of Bruchidae, the true seed insects feed and develop only in seeds while *Lasioderma serricorne* Fabricius and *Tribolium castaneum*, Herbst are general feeders attacking seeds extensively though in the wild state they are scavengers of plant and animal detritus.

The principal and most important pests of stored seeds of Leguminosae belong to genera *Bruchidius*, *Bruchus* and *Caryedon*. Larvae of nearly a dozen species of genus *Bruchidius* destroy the seeds during storage of *Acacia*, *Albizia*, *Cassia*, *Dalbergia* and *Prosopis*. Those of *Caryedon gonagra* Fabr. damage severely pods and seeds of *Acacia nilotica*, *A. tortilis*, *A. senegal*, *Albizia lebbeck*, *Cassia auriculata*, *Cassia fistula*, *C. montana*, *Prosopis juliflora*, *P. cineraria* and *Tamarindus indica*.

Apart from these, there are many insects which are basically field pests but are invariably carried to storage places and continue their depredation during storage. For example *Bruchus pisorum* Linn. is commonly found in storage places, but is not a storage pest. The larvae of this species and many other such species, infest the developing and growing seeds of *Albizia lebbeck*, *Cassia fistula*, *Dalbergia sissoo* while these are still on trees. There is no sharp demarcation between field and storage species of insect. Some species such as *Caryedon gonagra* Fab. attack young developing seeds on the growing plant as well as the stored seeds. But the majority of storage species are not known from growing pods and seeds. Again species such as *Bruchus pisorum* Linn. are commonly found in stores but are not true storage species. These develop in the growing and ripening tree seed in the field and emerge in storage. They are unable to breed in stored seeds.

Bruchidae whose larvae are specialist seed consumers (Utida, 1974) make up one of the very rare families which have colonized the ripe seeds of legumes, the Bruchinae sub-family is known from legumes only (Southgate, 1979). Owing to the specificity of legume allelochemical substances, the larvae of one bruchid species often consume the seed of only one species (Labeyrie, 1981). For example according to Janzen *et al.* (1977) 73% bruchid species of arborescent Leguminosae of the deciduous tropical forest in Costa Rica attack the seeds of one, 15% of two, 6% of three species. In High Volta there are 63% species with one host and 25% with two hosts (Labeyrie, 1981). In India 57.14% species, have one, 14.28% two, 14% three and 14% eight hosts.

Germination may be lost either from insect damage or from chemical treatment applied to kill insects. With seed any damage that prevents germination is paramount whether the embryo is eaten or killed in any other way. Farmers, foresters and horticulturists all demand a germination capacity close to 100% and sample of even germination. The seeds must also be of good appearance, free of live insects, holed seed and other obvious contamination such as webbing or insect droppings. Live insects are especially unwelcome because they spread readily in the warehouse to other produce.

Lamprey, *et al.* (1974) describe the role of seed beetle *Bruchidius spadicuse* Fabr., infesting seeds of *Acacia tortilis spirocarpa*

in Tanzania. A high proportion of seeds examined were infested and it was found that, unless ingested by a browsing mammal, the bruchid damaged the seed. Passage through the gut of a mammal, kills the larval insect and saves the seed viability resulting in relatively high germination rate. The ecological balance explored by Lamprey *et al.* (1974) in Tanzania and the Middle East, and Mathwig (1971) in Kansas, United States, has shown the importance of bruchids, as an important factor in the regeneration of leumingous trees in the semi-arid zones of Africa and North America. An understanding of their part in the ecology of our arid regions could help to stop the spread of these unproductive areas.

Factors influencing Insect infestation

Damage to seed depends considerably upon preventing insect attack on pods or preventing insects entering storage. Since the growth of insect populations tends to be exponential, should insects once gain entry, the build up of population is determined by the period of storage as well as the suitability of the environmental conditions inside.

Pre-harvest infestation : A major hazard is the infestation of the growing pods in the field by species able to multiply in store. Bruchid beetles often infest ripening seeds in the field. Field infestation is of dual importance because it limits the benefits of storage practices that otherwise exclude insects from stores and it prolongs the period available for multiplication. Prevett (1966 a) divides species of bruchids into three possible categories — the true field pests able to develop only on green pods, those that attack green pods and subsequently attack dry pods and those that lay eggs only when the pods are nearly dry and continue their activity into store. In the second category, he mentions *Bruchidius baudoni* Caillol that live in *Acacia* spp. In the final category of storage pests that start to infest seeds in the field he mentions *Callosobruchus subinnotata* which attacked *Voandzeia subterranea.* Another important bruchid genus *Caryedon*, includes several species fitting those two categories (Prevett, 1966 b). The majority are in the final category. *Caryedon gonagra* Fab. lays eggs on dry pods which remain on the tree like tamarind throughout the year.

Post-harvest (storage) infestation : The species of insect emerging from ripening seed fly into the buildings in which the harvested seeds is stored. The crop is invariably infested in the field when storage buildings in the neighbourhood harbour a large population of pests. They are often left behind in the bags, sacks, or bins in which the seeds are placed even in new sacks or bags if they are left in infested premises. The rates of development, oviposition and mortality are influenced considerably by light, temperature, humidity and moisture content and by the nutritive value of the seed. Insects lay more eggs in dark and damp store than in a light dry one. These eggs develop faster in a warm and fairly damp store especially in which their breeding is not disturbed. Not only do the insects populations, tend to increase exponentially, but the accumulation of metabolic heat raises the temperature of the seeds and accelerates the increase in numbers of insects. The consequence of these factors

is that each succeeding day, week and months of storage is increasingly hazardous if living insects are present.

Insect pests of pods/seeds on standing trees

Insects attacking seed and pods of leguminous trees in standing conditions mostly belong to orders Lepidoptera and Coleoptera. There are some hemipterous pests also. The true seed and legume pests belong to Coleoptera are mainly species of family Bruchidae.

Lepidoptera : *Cryptophlebia illepida* Butler (Tortricidae) is a widely distributed species. The larvae of this moth feed on the young pods of *Acacia nilotica*, *A. farnisiana*, *Bauhinia purpurea*, *Cassia fistula*, *Cassia occidentalis*, *Pithecellobium dulce*, *Sesbania aculeata*, *S. grandiflora* and *Tamarindus indica*. The full grown larva is 15-20 mm long. Yellow to reddish in colour with darker broken lines. Pupa is 8 mm long and pupal period is 7-14 days.

Laspeyresia palamedes Meyrick (Tortricidal) larvae feed on the flowers, green fruits and seed of *Bauhinia variegata*, *Caesalpinia* sp. and *Hardwickia binata*. Larvae of *L. malesana* Meyrick feed on the flowers and young pods of *Cassia auriculata*, *C. corymbosa* and *Parkinsonia aculeata*. The incidence of attack of *L. palamedes* in the pods and seeds of *B. variegata* varies from 10% to 60% in Dehra Dun Valley. *Trachylepidia fructicassiella* Ragonot (Pyralidae) is a major pest of the young and old pods of *Cassia fistula*. The larva is 25–30 mm long and destroys the pod and seeds. The incidence of attack is as high as 75%. It is a regular pest of the pods of *C. fistula*. *Spatularia mimosae* Stainton (Tineidae) larvae destroy seeds of *Acacia nilotica*, *Cassia corymbosa* and *C. fistula*. Larvae of *Anarsia ephippias* Meyrick (*Gelechiidae*) feed on the flower and seeds of *Mimosa rubicaulis* and larvae of *A. melanchropa* feed on the flowers and seeds of *Acacia gageana*. Caterpillars of *Microthrix omichleuta* Meyrick (Pyralidae) bore into the pods of *Acacia nilotica* and destroy seeds. Caterpillars of *Nephopteryx rhodosasalis* Hompson (Pyralidae) bore into green pods of *Cassia fistula*. Fruits of *Caesalpinia sappan* are destroyed by the larvae of *Oxyptilus chordites* Meyrick (Pterophoridae) by boring into the young pods. *Salebria pleurosaris* Meyrick (Pyralidal) larvae also bore into the fruits of *C. sappan*. Pods of *Albizia lebbeck* are damaged by the larvae of *Stathmopoda basiplectra* Meyrick (Heliodinidae). While the larvae of *Terastia eqialealis* Walk. (Pyralidae) bore into the fruit and shoot of *Erythrina suberosa*.

Hemiptera : Adults and nymphs of a bug *Pendulinus devastans* Distant (Coreidae) feed on the green pods of *Caesalpinia pulcherrima* by sucking sap. The coccids *Aspidiotus lataniae* Signoret, *A. orientalis* Newstead, *A. tamarandi* Green and *Lecanium oleae* Bernard, attack and damage the pods of *Tamarindus indica*.

Insect pests of seeds during storage

Coleoptera : Most serious insects damaging leguminous seeds during storage are bruchids. Besides, *Areaecerus* (Anthribidae), *Sitophilus* (Curculionidae) and *Tribolium* (Tenebrionidae) also attack seeds during storage. The family Bruchidae have 56 genera 10 of which are found in Old World

(Southgate, 1983). Important genera infesting forest seeds in India are, *Caryedon*, *Bruchidius* and *Bruchus*. *Caryedon gonagra* Fab. is one of the most serious pests of leguminous seeds in storage some times causing 100% loss of the seed of *Acacia tortilis* and *A. nilotica* in storage when stored as pods. The larvae of this beetle damage pods and seeds of *Acacia nilotica*, *A. chundra*, *A. farnesiana*, *A. pinnata*, *A. tortilis*, *A. senegal*, *Albizia lebbeck*, *Bauhinia malabarica*, *B. racemosa*, *Cassia fistula*, *C. montana*, *Hardwickia binata*, *Prosopis cineraria*, *P. juliflora* and *Tamarindus indica*. Biology of *C. gonagra*, has been studied in the laboratory on seeds of *Acacia tortilis*. An account of biology of this pest has been given by Pruthi & Singh (1950).

Caryedon languidus Gyllenhal (Bruchidae) larvae feed on the seeds of *Cassia auriculata*. *Bruchidius andrewesi* Pic. larvae feed on the seeds and pods of *Acacia leucopholea*. *B. saundersi* Jekel and *B. sparsemaculatus* Pic. damage seeds of *Albizia lebbeck*. *B. uberatus* Feb. larvae bore into the seed and pods of *Albizia amara*, *A. chinensis*, *A. odoratissima*, *A. procera*, *Dalbergia paniculata* and *Prosopis juliflora*. *B. urbanus* Sharp larvae damage the seeds and pods of *Albizia julibrissin*.

Callosobruchus chinensis Linn. feed on the pods and seeds of *Acacia tortilis*. *Bruchus bilineatopygus* Pic. larvae damage pods and seeds of *Acacia leucophloea*. Larvae of *B. vectabilis* Gyllenhal destroy pods and seeds of *Sesbania aculeata*.

Araecerus fasciculatus DeGeer. (Anthribidae) larvae damage pods and seeds of *Bauhinia accuminata*, *Caesalpinia pulcherrima Cassia occidentalis* and *Leucaena*, *A. simulatus* Gyllenhal larvae damage pods and seeds of *Dalbergia sissoo*. Pods and seeds of *Acacia nilotica* and *Cassia auriculata* are destroyed by the larvae of *A. suturalis* Boheman. *Sitophilus linearis* Herbst (Curculionidae) larvae destroy seeds and pods of *Pongamia pinnata* and *Tamarindus indica*, *Gonocephalum planatum* Walker (Tenebrionidae) larvae feed on the sown seeds of *Xylia dolabriformis*. *X. xylocarpa*, *Lassioderma serricorne* Feb. (Anobiidae) larvae damage the seed of *Tamarindus indica*. *Tribolium castaneum* Herbst. (Tenebrionidae) larvae also feed on the seeds of *T. indica*.

Control of insect pests of pods seeds of standing trees

Insect pests feeding on the pods/seeds are controlled by spraying insecticides in the field. The treatment may be given to individual branches, individual small tree, individual large tree and seed production areas. Insects infesting pods of *Acacia* spp. can be controlled by spraying endosulfan or tetrachlorovinphos (Southgate, 1983). Use of orthene or cythion was suggested by Felker *et al.*, (1981) for controlling the insects affecting seeds and fruits. For control of bruchids infesting standing crop spray of parathion or malathion was suggested (Metcalf *et al.*, 1962) and Habit *et al.*, (1981). Sap sucking insects may be controlled by the application of furadon 10 G (Felker *et al.*, 1981) fenitrothion, carbaryl (Ruperez, 1978), endosulfan, monocrotophos (Saxena, 1978, Leon, 1974). Use of Cythion have been recommended by Habit *et al*, (1981) and Smith and Ueckert (1974).

The timing of insecticidal applications depends on the life-histories of the insect involved and also on the flowering and fruiting cycle of the crops. For leguminous crops usually three application have been suggested, (i) a bud stage application to ensure development of flowers, (ii) an early bloom stage application to maintain the bloom, and (iii) a late bloom stage application to protect the developing seed and pod. Care should be taken if the insecticide is being applied at the time of blooming. It should be applied only in hours when pollinators are not on the crop (Bohart and Koerber, 1972).

Control of Seed Pests during storage

How do these insects enter the seed in the store? Some of them like the *Bruchus pisorum* Linn. appear in the field when the seed is ready for harvest. They deposit eggs on the pod/seed. The eggs later hatch out and carried to the store. In a godown or store which was previously used for storing seeds, insect pests continue to breed in left-over material on the floor or in the cracks on the walls. Thus, when the new stocks come in, they easily move into the fresh arrivals. When a new stock is stored side by side with old stock, which has insect attack, insects can just walk over to the new seed. Seed containers and vehicles also help insects spread. When old gunnies are re-used, or when vagons, trucks or carts, used for transporting seed, are used again for the same purpose the insects hiding in them get into the new seed.

Hence, you have to take steps to prevent insect attack, and when there is attack, to control it. First, thoroughly clean and disinfect the place of storage. Have all cracks and crevices plastered. Small quantities of seeds should be stored in closed and sterilized containers. Structures proposed for bulk seed storage should have controlled ventilation, high plinth, and freedom from leakage/dampness. The insects do not thrive in neat and clean places. Before receiving the seed, the store should be thoroughly brushed with broom and disinfested by the use of BHC smoke generators @ 2 kg per 1000 m^3 or by spray of 0.3% pyrethrins water emulsion or 0.125% malathion 50 EC @ 3 litres per 1000 m^2. If the storage structure is of such type that all its surfaces are not easily accessible for spraying, space fumigation may be carried out. Fumigate the gunnies or treat them with malathion before re-use. Similarly, disinfest all vehicles used for transport with malathion. Insects already present in the store, containers, gunnies and vehicles will thus be killed, and the chances of fresh seed getting insect-attack are very much reduced.

At the time of receipt of seeds, seed should be inspected for its moisture content, its general condition and for presence of live insect. Dry seeds keep well in storage. Infested seeds should be removed by visual method or by seiving method before storing them. In case the seed is infested it may be stored and fumigated in small air tight containers. Closed space fumigation of infested seeds with carbon di-sulphide, ethylene bromide, dichlorvos, mixture of carbon di-sulphide and carbon tetra chloride, bromophos, (Ruperez, 1978), hydrocyanic acid gas, mixture of carbon tetra-chloride

and ethylene dichloride (Southgate, 1978) and phosphine (Hole, *et al.*, 1976) pirimiphs methyl (Taylor & Evans, 1980) has been recommended. Calculated dosage of fumigant should be used and mouth of container sealed. 3 ml of fumigant is sufficient for fumigating one quintal or less seed. Care should be taken that the fumigant should not come in contact with the seeds. Most of the fumigants are phytotoxic. Only fumes will kill the existing attack.

When seeds are to be stored for longer period in jute bags. The surface of the bag should be treated with pyrethrin dust, malathion dust or BHC dust to avoid insect infestation. Aplication of BHC 5% dust or pyrethrin 0.06% dust @ 25 grams per m^2 of surface may be done on the outer surface of the bags. Phorate 10 g is also used in seed storage for preventing insect attack. The insecticide is thoroughly mixed with seeds in seed dressing drums before storage. Spraying of 0.07% pyrethrin 2.5 EC water emulsion or 0.125% malathion 50 EC water emulsion @ 3 litres per 1000 m^2 of spray emulsion, can prevent cross infestation. Let the spray not soak or wet the bags These treatments may be repeated every month (Anon, 1964).

Some traditional methods are still popular in many parts of world for the control of insect pests of seeds in storage particularly for bruchids. Some plants or plant parts are used as crude decoction, i.e., *Azadirachta indica* (neem kernels), *Capsicum* (pepper chilis), *Cactus* spp. (stem powder), *Anona reticulata* (custard apple seed powder), *Mundulia sericea* (stem bark powder), *Piper nigrum* (black pepper powder) *Madhuca latifolia* (stem bark powder), (Golob and Webley, 1980). Powder of the rhizome of *Acorus calamus*, powder of drupes of *Thevetia nerifolia*, leaf powder of *Adhatoda vasica* and leaf powder of *Ipomoea cornea* have also shown good protection against pulse beetles (Pandey *et al*, 1976). Plant extracts have also been used against bruchides in seed storage, i.e., Neem (*Azadirachta indica*) seed oil (Golob and Webley, 1980; Pandey *et al.*, 1976). Oil of *Acorus calamus*, *Derris elliptica*, *Pogostemon heyneanus* (patchouli oil), *Nigella sativa* (black cumin oil), *Phaseolus vulgaris* (bean oil) (Golob & Webley, 1980), oil of *Allium sativum* and *A. cipa* (Pandey *et al.*, 1976), extract of *Piper nigrum* was successfully used against cow pea weevil (Su, 1977).

Conclusion

Seed entomology especially of seeds of Leguminosae was a neglected subject in the past in the country. Taking into consideration the importance of Leguminosae seed in forestry as fuel and fodder species and the huge requirement of sound seed for large scale wasteland afforestation programmes, it is very essential to study their seed entomology. In order to protect the seed wealth of forest trees, detailed studies on the biology, life-history and ecology of seed insects should be carried out to evolve effective and economic control measures. A better understanding of role of seed insects in the ecology of our arid regions could help stopping the spread of unproductive areas. Investigations into the nature and role of allelochemicals of seeds vis-a-vis their insect enemies may help to evolve better and safer control measures.

SUMMARY

Leguminous tree species are important in social forestry and wasteland development programmes, hence there is a great demand for their seeds. For raising large nursery stock, huge quantities of sound seed is required. But seed entomology of the leguminous tree seeds has long been a neglected subject. These seeds are often liable to be destroyed by insects. A large number of insects belonging to orders, Coleoptera, Lepidoptera feed on pods and seeds in nature and during storage. Most important of these are bruchid beetles of the genera *Caryedon*, *Bruchidius* and *Bruchus*. In most of the cases insect attack commences from the tree itself. Larvae of tortricids pyralids, gelechids and heliodenids also cause considerable damage to pods and seeds. Short account of these injurious insects feeding on lenguminous seeds and their control measures are given in this paper. The fight against bruchids which often destroy more than half of the seeds has been unsuccessful so far because it has not been based on an adequate knowledge of the biology of these beetles and in particular of how they infest leguminous seeds at harvest time, most of them are wrongly believed to attack only stored seeds. Entomologists must remedy the situation if further advances are to be made in social forestry and wasteland development.

वन वृक्षों के बीजों पर लगने वाले नाशिकीट तथा उनका नियन्त्रण

प्रताप सिंह व आर०एस० भण्डारी

सारांश

सामाजिक वानिकी और बंजर भूमियों के विकास कार्यक्रमों में शक्तिकुल की वृक्ष जातियों का बहुत बड़ा महत्व है, इसलिए उनके बीजों की बहुत मांग है। बड़ी रोपणियों में पौध उगाने के लिए अच्छा बीज बड़ी मात्रा में चाहिए। परन्तु बजों पर लगने वाले कीड़ों का विज्ञान काफी समय से उपेक्षित विषय रहा है। बहुधा यह बीज कीड़ों द्वारा बरबाद होता है। कोलियोप्टेरा (कचुक पक्षा:) और लेपिडोप्टेरा (शल्कि पक्षा:) गणों के बहुत सारे कीडे प्रकृति में तथा भण्डारण करने पर फलियों और बीजों पर पोषित होते हैं। इनमें सबसे ज्यादा महत्व वाले कैर्येडान, ब्रूकिडियस और ब्रूकुस प्रजातियों के ब्रूकिड भृग हैं। अधिकांश मामलों में कीड़े वृक्ष पर ही लगने शुरु हो जाते हैं। ट्रॉट्रिसिड, पायरालिड, गेलेकिड और हेलियोडेनिडों के जातक भी फलियों और बीजों को बहुत हानि पहुँचाते हैं। प्रस्तुत अभिपत्र में शिम्बिकुलीय बीजों पर पोषित होने वाले हानिकर कीड़ों का सक्षित वर्णन और उनकी रोकथाम के उपाय दिए गए हैं। इन कीड़ों के विरुद्ध, जो बीजों का आधे से अधिक भाग बरबाद कर देते हैं, लड़ी जाने वाली लड़ाई अभी तक असफल रही है क्योंकि यह इन भृगों की जैविकी के विषय में अपर्याप्त ज्ञान पर आधारित रही है, विशेषत: इस बात को कि फसल के समय ये शिम्बिकुलीय बीजों पर किस प्रकार लग जाते हैं, तथा उनमें से अधिकाँश गलती से केवल भण्डारित बीजों पर आक्रमण करते विश्वास किए जाते हैं। कीट विज्ञानियों को इस स्थिति का उपचार करना चाहिए यदि हमें सामाजिक वानिकी और बंजर भूमि विकास में कुछ प्रगति करनी अभीष्ट है।

References

Anon (1964). Insects encountered in handling of food grains and their control. *Grain Storage Research & Training Institute, Hapur (U.P.). Leaflet* No. 1, 14 pp.

Beeson, C.F.C. (1941). *The Ecology and Control of Forest Insects of India and Neighbouring Countries.* Manager Publications, Government of India, New Delhi, 1007 pp.

Bohart, G.E. and T.W. Koerber (1972). Insect and seed production. *Seed Biology*, Vol. 3. edt. Kozlowski, T.T., Academic Press, New York, 1-50 pp.

Felker, P., G.H. Cannel and P.R. Clark (1981). Variation in growth among 13 *Prosopis* (mesquite) species. *Expl. Agric.*, **17** : 204–218.

Golob, P. and D.J. Webley (1980). The use of plant and minerals as traditional protectant of stored products. *Report of the Tropical Product Institute*, G 138, Vit, 32 pp.

Habit, M.A., D.T. Contreras and R.H. Gonzaliz (1981). *Prosopis tamarugo*, arbusto forragero para zonas arides. Eotudio FAO Production Y. Protection vegetal. *Organization de la. Naciones Unidas para la Agricultura Y la* Alimentacion Roma, 143 pp.

Hole, B.D., C. H, Bell, K.A. Mills and G. Goodship (1976). The toxicity of phosphine to all developmental stages of thirteen species of stored product beetles, *J. Stored Product Research*, **12** : 135–244.

Janzen, D.H., H.B. Juster and E.A. Bell (1977). Toxicity of secondary compounds to the seed eating larvae of the bruchid beetle. *Callosobruchus maculatus. Phytochemistry*, **16** : 223–227.

Labeyrie, V. (1981). Ecological problems arising from weevil infestation of food legumes. *Series Entomologica*, **19** : 1–15.

Lamprey, H.F., G. Harlery and S. Makacha (1974). Interaction between *Acacia* bruchid beetles and large herbivores. *E. Afr. Wildl. J.*, **12** : 81–85.

Leon, H. (1974). Estudio comparativo de espolvores Y plverizaciones para al control de insectosdel tamamgo (*Prosopis tamarugo* Phil). Tesis Fac. Agronomia Universidad de Chile, Stgo-58 pp.

Mathur, R.N., Balwant Singh and Kishori Lal (1958). Insect pests of flowers, seeds and fruits of forest trees. *Indian For. Bull.*, No. 223. (*Ent. New Series*), 105 pp.

Mathwig, J.E. (1971). *Relationship between bruchid beetles* (*Amblycerus robiniae*) *and honey locust trees.* (*Gleditsa triacanthos*) Ph.D. Thesis. Kansas State Univ. Manhattan, 169 pp.

Metcalf, C.L., W.P. Flint and R.L. Metcalf (1962). *Destructive and Useful Insects* (4th edt.). McGraw Hill Book Co., New York. 1087 pp.

Pandey, N.D., S.R. Singh and G.C. Tiwari (1976). Use of some plant powders, oils extracts as protectants against pulse beetle, *Callosobruchus chinensis* Linn. *Indian Journal of Entomology*, **30** : 110–113.

Prevett, P.F. (1966a). Observations on biology of six species of Bruchidae (Coleoptera) in Northern Nigeria. *Entomol. Mon. Mag.* **102** : 174.

Frevett, P.F. (1966b). Observations on biology in the genus *Caryedon* Schoenherr in Northern Nigeria, with a list of parasitic Hymenoptera. *Proc. L. Entomol. Soc , London Ser. A.* **41** : 9–16.

Pruthi, H.S. and Mohan Singh (1950) *Pests of stored grains and their control.* Manager of Publication, Govt. of India, New Delhi, 88 pp.

Ruperez, A. (1978). Problems de entomologia forestal in Peru. Con especial attencion sobre and algarrobo. *Organizacion de las Naciones Unidas para la Agriculture Y La Alimentacion*, 51 pp.

Saxena, H P. (1978). Pests of grain legumes and their control in India. *Pests of grain legumes's Ecology and Control.* (edts) Singh, S.R., Van Enden, H.F. and Taylar, T.A., Academic Press, London 15–23 pp.

Sen-Sarma, P.K., M.L. Thakur and H.S. Sehgal (1986). Protection of forest seeds against insect pests and fungi during storage. *Proc. National Seminar on Forest tree seeds*, Hyderabad. 137–146 pp.

Singh, Pratap and R.S. Bhandari (1986). Insect pests of forest tree seeds and their control. *Proc. National Seminar on Forest tree seeds*, Hyderabad. 155–171. pp.

Smith, L L. and D.N. Ueckert (1974). Influence of insects on mesquite seed production. *Journal of Range Management*, **27** : 61–65.

Southgate, B J., (1978). The importance of the Bruchidae as pests of grain legumes, their distribution and control *Pests of Grain Legumes : Ecology and Control* (edts.) Singh, S.R., Van Enden, H.F. and Taylor, T.A., Academic Press, New York. 219–229.

.... (1979). Biology of the Bruchidae. *Ann. Rev. Entomol.*, **24** : 449–473.

.... (1983). Hand-book of seed insects of *Acacia* spp. *Food and Agricultural Organization of United Nation, Rome.* 30 pp.

Su, H.C.F. (1977). Insecticidal properties of black piper to rice weevil and cowpea weevil. *J. Econ. Entomol.* **70** : 18–21.

Taylor, R.W.D. and N.J. Evans (1980). Laboratory evaluation of primiphos methyl and permethrin dust for control of bruchid beetles attacking stored pulses. *International pest control*, **15** : 108–110.

Utida, S. (1974). Polymorphism in a adult of *Callosobruchus maculatus*, a possible process of evolution to stored product pest. *Proceed 1st Int. Workshop Cont. Stor. Prod. Ent.*, 689–91.

A COMPARATIVE STUDY OF CCA TREATMENT OF TREE GUARD POLES OF *EUCALYPTUS* HYBRID BY SAP-DISPLACEMENT AND BOUCHERIE PROCESSES

S.N. SHARMA,* P.V. KRISHNA RAO AND V.V. SRINIVASAN

Institute of Wood Science and Technology, Bangalore (Karnataka)

Introduction

Preservative treatment of round poles for transmission lines and structural uses is generally carried out by the standard pressure treating process. A more or less uniform absorption of preservative and distribution of preservative components along the length of the pole is to be expected by this process. The pressure treating process has however not been adopted for fence posts and tree guard poles for various practical reasons such as the generally higher cost of treatment in a plant, double transportation involved in taking the poles to plant and then to site of use and non-availability of a nearby treating plant in many cases.

The sap-displacement and diffusion (non-pressure) processes and the Boucherie (low pressure) process have been investigated for use in such situation (Chandra & Gupta, 1973; Gupta & Chandra, 1972; Kumar & Tewari, 1976; Nagaraja Sharma *et al.*, 1948; Shukla and Kambo, 1976 and Tewari *et al.*, 1967). These have to be applied to green (preferably freshly felled) timber and are best adopted at the felling site, thus eliminating the necessity of partial seasoning before pressure treatment and the additional cost of transportation to the treatment plant They involve much simpler and low-cost treating equipment which can be operated by unskilled persons.

Investigations made on the treatment of *Casuarina* fence posts by sap-displacement using CCA (Nagaraja Sharma *et al.*, 1984) have revealed that while satisfactory overall absorptions of preservative can be attained by adjusting the treatment time and concentration of treating solution, the absorption of CCA, and particularly of arsenic, tends to be highly deficient in the mid-length portions. Similar data on longitudinal distribution of preservative and its components attained by the Boucherie process has been lacking (Shukla & Kambo, 1976).

Objective

This paper compares the results of experiments carried out on treatment of freshly felled tree guard poles of *Eucalyptus* hybrid with CCA by the sap-displacement and Boucherie processes. The results relate to the process times required, overall absorption and penetration of preservative and the longitudinal distribution of preser-

* Presently Head, Forest Products Division, Forest Research Institute, Dehra Dun (India).

vative components achieved under the two processes.

Material and Methods

Material: Freshly felled poles of *Eucalyptus* hybrid were used for treatment under both processes. The poles were prepared from stems of trees of around 3-4 years age and in no case branchwood was used. Poles in 2.3 m length and two girth classes, viz, 14-19 cm and 20-26 cm, were selected. CCA solution of 11% nominal concentration in the ratio 1 : 3 : 4 (As : Cu : Cr) by wt. was used for the treatments.

Treatment: (i) *Sap-displacement process*—The green poles were debarked, carefully removing the inner bark also. They were then made to stand vertically with their butt ends submerged upto about 40 cm length in CCA solution in a tank for 48-72 hrs as judged by the ascent of the preservative on their lateral surface and by spot tests made after cutting some of the poles at intervals. The ends were then reversed with the top ends now submerged in solution for further 12 hrs. In all, 30 poles, 17 of lower and 13 of higher girth class, were treated. Additional 6 poles were installed in the treating tank for periodic spot tests.

(ii) *Boucherie process*—The butt ends of green poles with the bark and branches intact were inserted and clamped into the hose outlets of the Boucherie equipment provided with a solution tank. A constant air pressure 0.7 kg/cm^2 was applied to the preservative solution. The time, when the colour of clear sap-dripping from the exit end of the pole changed first, was recorded. Treatment was continued till the drip became heavily coloured. In all 7 poles, 3 and 4 of each girth class, were treated.

Penetration and absorption tests: 3 poles treated by sap-displacement and 2 by Boucherie method were analysed for CCA absorption and longitudinal distribution of CCA components. For this, each pole was divided into 7 pieces of equal length, i.e., about 30 cm. Discs comprising the entire pole cross section were cross cut from the centre of each piece, dried at room temperature and then reduced to dust for analysis of individual CCA components and the overall CCA absorption as percentage of the O.D. wt. of the wood.

Three samples were taken from top, middle and bottom positions of each pole for determination of average pole density on an O.D. wt./air-dry vol. basis, the air-dry vol. being determined after room drying of each sample for about a month. The analysis results were multiplied by the average density of the respective pole in order to convert the absorptions to a unit volume of air-dry wood basis.

In addition to preservative analysis, depth of penetration of the preservative in the circular section from the periphery was examined by spot test on the end section of each of the 7, 30 cm pieces cross cut from the pole.

Results

Sap-displacement process : (i) *Treatment time and penetrations achieved* — The data on the height of ascent of CCA and lateral absorption in the section as determined by spot tests on two poles each removed from the tank after 24, 48 and 72 hrs of immersion of the butt ends is set out in Table 1. After 24 hrs immersion, one pole showed lateral absorption to a depth of 5 mm or over from

Table 1

Section penetration from the periphery achieved at different positions in length during sap-displacement treatment

Ht. from butt end (m)			0.53	0.71	0.89	1.07	1.24	1.42	1.60	1.78	1.96
Pole No.	Girth at butt end (cm)	Period of Immersion of butt end	Depth of penetration from periphery (mm)								
0–3	14	24 hrs	Full except pith	90%	90%	5-10	5-7.5	2.5-6.5	2.5-6.5	Traces	—
4–1	21.6	”	2.5-7.5	1.5-6.5	2.5-4	Traces	Traces	—	—	—	—
10–2	22.9	48 hrs	10-60	9-14	6.5-10	5-7.5	4-13	6.5-9	2.5-4	—	—
18–2	14.2	”	10-18	9-15	6.5-10	6.5-7.5	5-9	5-7.5	2.5-6.5	—	—
17–2	9.5	72 hrs	18-24	18-24	14-19	10-18	4-7.5	5-6.5	4-6.5	Traces	Traces
9–2	20.3	”	Full except pith	5-13	5-10	4-7.5	5-6.5	4-5	2.5-5	1.5-5	Traces

the periphery upto a height of only 1.24 m and the other upto less than 0 53 m height. 24 hrs immersion of butt ends was therefore considered insufficient. The two poles removed after 48 hrs immersion attained lateral absorption to minimum 5 mm depth upto a height of 1.42 m. Of the two poles removed after 72 hrs immersion, one showed lateral absorption of at least 4 mm upto a height of 1 60 m and the other to a height of 1 42 m The rate of ascent did not appear to depend on the girth of poles.

Based on this data, 48-72 hrs immersion of the butt ends is considered necessary to attain satisfactory preservative absorption to a height of about 1.5 m. i e. 2/3rd height of the 2.3 m poles. The necessity of the longer period of immersion of 72 hrs for part of the poles in this test was decided by visual examination of the height of ascent of the preservative on their cylindrical surface.

The 48-72 hrs immersion of butt ends was followed by reversal of the ends and treatment of the top ends for further 12 hrs. Table 2 gives the lateral absorption measured after spot tests in the 3 sample poles which were used for preservative analysis after they had undergone treatment from both ends. It is seen that satisfactory lateral absorption had been achieved at all positions in length, including mid-length.

(ii) *Distribution of preservative and its components.*—The trend of distribution of preservative and preservative components along the length of the pole (Table 3) is essentially similar to that observed in studies on sap-displacement treatment of *Casuarina* fence posts carried out elsewhere (Nagaraja Sharma *et al.*, 1984). The CCA absorption is as high as 66 to 83 kg/m^3 at the butt end. It decreases to a minimum of 8.5–12.1 kg/m^3 in the central portions corresponding to discs D & E. It again increases to a maximum of 36.7 to 44.4 kg/m^3 at the top end. CCA absorption in the pole as a whole varies from 26 to 31 kg/m^3 which is

Table 2

Section penetration from the periphery achieved at different positions in length after 60-40 hrs sap-displacement treatment.

Position along the length of pole / Pole No. and girth at butt end (cm)	A (Butt)	B	C	D	E	F	G (Top)
	Depth of penetration from periphery (mm)						
0–1 (21.7)	19–25	15–23	Full	15–20	Full	Full	Full
8–1 (14.5)	Full	6.25	Full	Full	Full	Full	Full
17–2 (17.7)	Full	Full	Full	Full	5–7.5	7.5–13	Full

Table 3

Longitudinal variation of absorption of CCA and its components in poles treated by sap-displacement

Pole No. & dencity	0-1 d=0.72				8-1 d=0.71				17.2 d=0 65			
	(Absorptions kg/m³)											
Position in length	As	Cu	Cr	CCA	As	Cu	Cr	CCA	As	Cu	Cr	CCA
A (Butt)	6.5	27.4	32 4	66 2	9.2	32.7	41.2	83.1	9.8	34	36.6	80.3
		(1 : 4 2 : 5)*				(1 : 3 5 : 4.5)				(1 : 3.5 : 3.7)		
B	—	10.8	15.8	26.6	—	14.2	15.6	29.8	—	16 3	18.3	3 .6
C	—	8.6	7.9	16 6	—	8.5	7.8	16.3	—	7.2	9.8	17
D	—	5.0	3 6	8.6	—	7.8	7.1	14.9	—	5.2	5.2	10.4
E	—	6.5	6.5	13	—	5	7.1	12.1	—	4.6	3.9	8 5
F	—	5.8	8.6	14.4	—	8.5	7 8	16.3	—	5.9	5.9	11 7
G (Top)	2.9	18	15.8	36.7	4.3	17.7	20.6	42.6	3 9	20 2	20.2	44.4
		(1 : 6.2 : 5.5)				(1 : 4.2 : 4 8)				(1 : 5 2 : 5 2)		
Entire pole basis absorptions	1.3	11.7	13	26	1.9	13.5	15.3	30 7	2	13.3	14.3	29.6
		(1 : 8.7 : 9.7)				(1 : 7 : 7.9)				(1 : 6 8 : 7.3)		
Treating Soln. (%)	1.4	5.7	6.2	13 3								
		(1 : 3.9 : 4.3)										

* Proportion of CCA components (As : Cu : Cr) are indicated in paranthesis.

NB : CCA absorption specified for fence posts in IS : 401-1982-16 kg/m³ (As 2, Cu 6 & Cr 8 kg/m³).

quite in excess of 16 kg/m³ specified for fence posts under IS : 401–1982. Absorptions at mid-length however happen to be rather deficient.

There is an out of proportion (deficient) absoprtion of arsenic pentoxide compared to that of copper sulphate and potassium dichromate except at the ends of poles and the proportion of constituents as in the treating CCA solution is not maintained in different portions. In fact, with 13.3% concentration of CCA solution used compared to 15.3% in the aforesaid study (Nagaraja Sharma *et al.*, 1984) and also the shorter overall treating times of 60–84 hrs compared to 119.5 hrs in that study, there has been negligible absorption of arsenic except at the ends of the poles. Rapidly increasing disproportionation of arsenic (in the adverse direction), from 1 : 2.4 : 3.1 and 1 : 2.7 : 3.5 at the butt and top ends to 1 : 20 : 38 at mid-length, was however registered in the aforesaid study on *Casuarina* poles as well as even with 15.3% CCA solution.

Absorptions of copper sulphate and potassium dichromate are also deficient in the central portions of poles compared to the specified levels of 6 and 8 kg/m³ respectively (Anon., 1982) as in the study reported on *Casuarina* poles (Nagaraja Sharma *et al.*, 1984.)

Boucherie process : (i) *Treatment time and penetrations achieved*—Appreciable variation in treatability of the poles was noticed under this process. Of the seven poles tried, drip started in six within 10 min. of application of pressure whereas in one it started only after 35 min. Colourless sap-continued dripping for periods varying from 37 to 110 min. in the different poles before it changed colour. It took further 1 hr to 2 hr 40 min. before deeply coloured solution started dripping. The treatment times upto this stage varied from 2 hr 15 min. to 4 hr 40 min. in the seven poles. The flow was continued for further 1 hr to 4 hr 40 min. beyond this stage in the different poles to collect sufficient exit solution for analysis. It took 20 to 50 min. per 50 cc of solution to drip in different poles. The overall periods involved varied from 3 hr 55 min. to 7 hr 8 min. since application of pressure.

Table 4 gives data on the depth of lateral penetration at different positions along the length of two treated poles that were selected and cut for preservative analysis It indicates that satisfactory lateral penetration was achieved at all positions in both the poles.

(ii) *Distribution of preservative and its components*—Considering the distribution of preservative in the poles (Table 5), a distinct gradient of preservative absorption is noticed over the entire length of poles from the butt (inlet) to the top (exit) end. The CCA absorption was as high as 90 to 99 kg/m³ at the inlet end and fell to 12 to 15 kg/m³ at the exit end. The absorptions in the pole taken as a whole (41% to 48%) were well in excess of the specified value.

As regards the distribution of CCA components, the results were a distinct improvement over the sap-displacement process for identical nominal concentration of 11% of treating solution. A more evenly distributed absorption of arsenic pentoxide was obtained over the entire length of the

Table 4

Section penetration from the periphery achieved at different positions in length after Boucherie treatment.

Position along length of pole	A (Butt)	B	C	D	E	F	G (Top)
Pole No. and girth at butt end (cm)	Depth of penetration from periphery (mm)						
A-5 (18.5)	Full	Full	Full	Full	Full	6.5–19	13–15
A-6 (15.1)	Full	Full	Full	Full	Full	Full	12 5

pole. The absorptions (15.6 to 3.6 kg/m^3 in one and 16 5 to 3.3 kg/m^3 in the other pole) were well in excess of the specified 2 kg/m^3 over the first 4 sections, i e., about half the length of the poles from the inlet end. They were at least at half the specified value, i.e., 1 kg/m^3, in the further 2 sections. Even in the exit end section absorption was to ¼th to 1/3rd the specified value i.e., 0.5 kg/m^3. By contrast, absorption of arsenic pentoxide achieved was negligible except in the butt and top sections by sap-displacement treatment carried out for 60–84 hrs. The absorptions of copper sulphate were in excess of the specified 6 kg/m^3 over the entire length of poles treated by Boucherie process, while those of potassium dichromate approached or were well in excess of the specified 8 kg/m^3.

Though the adverse disproportionation or arsenic absorption rapidly increased from the inlet to the exit end, it was maintained reasonably close to the proportion of constituents in the treating CCA solution upto 4/7th of the length of the pole from the inlet end. Even at the exit end the arsenic disproportionation (1 : 13 : 10 in one and 1 : 11 : 10 in the other pole) was of a much lower order than that corresponding to the complete absence of arsenic in the central portion of poles treated by sap-displacement in the present experiment or the value (1 : 20 : 38) obtained in the central portion of *Casuarina* poles treated by sap-displacement by Nagaraja Sharma *et al.*, (1984). Considering the pole as a whole, the proportions 1 : 3.9 : 3.1 and 1 : 4.5 : 3.8 were quite close to that in the treating solution.

The proportion of arsenic pentoxide relative to the other two constituents was found to be higher (1:1.2:1.8 and 1:1.2:1.6) in the solution drip collected at the exit end than in the treating solution impregnated at the inlet end of poles, which is an interesting observation.

Discussion

The absorptions in the Boucherie process at the exit end of the pole fell to 13.4–15.4% of the absorptions at the inlet end for CCA, to 14.4–18% and 16.6–17.2%

Table 5

Longitudinal variation of absorption of CCA and its components in poles treated by Boucherie process

Pole No. & density	A-5 d = 0.58				A-6 d = 0.61			
	Absorptions (kg/m³)							
Position in length	As	Cu	Cr	CCA	As	Cu	Cr	CCA
A (Butt)	15.6	39.1 (1 : 2.5 : 2.3)*	35.5	90.3	16.5	44.4 (1 : 2.7 : 2.3)	38.3	99 2
B	8.5	29.7 (1 : 3.5 : 2.7)	23.2	61.4	8 5	36.8 (1 : 4.3 : 3 2)	27.6	72.9
C	5.4	23.9 (1 : 4.4 : 3.5)	18.8	48.2	5	27.2 (1 : 5.5 : 4.5)	22.6	54.8
D	3.6	18.8 (1 : 5.2 : 3.6)	13	35.5	3 3	20.7 (1 : 6.3 : 5.8)	18.8	42.7
E	1.4	12.3 (1 : 8.8 : 5.7)	8	21.7	1.5	16.1 (1 : 10 9 : 8.5)	13	30.6
F	0.9	10.1 (1 : 11.3 : 7.3)	6.5	17.6	1	11.5 (1 : 10.9 : 10.6)	11.1	23.6
G (Top)	0.5	6.5 (1 : 13 : 10.2)	5.1	12.1	0.7	7.7 (1 : 11.1 : 10)	6.9	15.2
Entire pole basis absorptions	5.1	20.1 (1 : 3.9 : 3.1)	15.7	41	5.2	23.5 (1 : 4.5 : 3.8)	19.8	48.5
Exit Soln. (%)	0.12	0.15 (1 : 1.2 : 1.8)	0.22	0.50	0.29	0.35 (1 : 1.2 : 1.6)	0.46	1.10
Inlet Soln. (%)	1.1	4.01 (1 : 3.6 : 4.3)	4.8	9.9				

* Proportion of CCA components (As : Cu : Cr) are indicated in paranthesis.

NB : CCA absorption specified for fence posts in IS : 401-1982—16 kg/m³ (As 2, Cu 6 & Cr 8 kg/m³).

for potassium dichromate and copper sulphate, and to 3.2–4.2% for arsenic pentoxide. The absorptions in the sap-displacement process at the centre of poles fell to 10.6–14.5% of the absorptions at the butt ends for CCA, to 10.7–17.2% and 13.5–18.4% for potassium dichromate and copper sulphate, and to nil for arsenic pentoxide. Absorptions of potassium dichromate and copper sulphate in both processes thus closely followed total CCA absorptions. An adverse progressive disproportionation of arsenic relative to the other two components however takes place in both processes in the direction of movement of the preservative, i e., towards the exit end in the Boucherie and towards the centre of the pole in the sap-displacement process. The preservative has to more over approximately double the distance through wood in the former than in the latter process. Appreciable disproportionation of absorbed components relative to the treating solution is generally not come across in the standard pressure treating process (Kuppuswamy & Sharma, 1986).

Some salient differences of conditions under which treatment proceeds under these different processes may be noted :

(i) The wood under standard pressure treatment process is usually in partially air-dry condition whereas the Boucherie and sap-displacement processes are carried out on green wood. Differences in chemical activity of wood between the dry and green conditions cannot be ruled out.

(ii) The pressure treatment process essentially consists in filling up of the voids in wood with preservative solution which stays inside the cells after treatment. Prolonged time for interaction of the preservative with the wood constituents is available. On the other hand, the interaction in the Boucherie and sap-displacement processes takes place with a moving stream of preservative which is being replenished with fresh preservative behind it and at a faster rate in the former process.

(iii) Dilution of the preservative with the cell sap is likely to be continually involved in the Boucherie and sap-displacememt processes, resulting in disturbance of pH of the preservative solution and molar conc. of its components to a greater extent with the distance moved. Considerable dilution occurred as evidenced by the large difference in strengths of the inlet and exit solutions in the Boucherie process.

Fixation of CCA components in wood is known to be influenced not only by pH of the preservative solution but also by the relative concentration of its components (Bror Hager, 1969). Reaction time available also influences fixation of individual components (Pizzi, 1983). Arsenic fixation is believed to occur through complexation with chromium and therefore is also limited by the available chromium (Pizzi, 1983 and Pizzi *et al.*, 1986) The reason for significant progressive disproportionation of arsenic in the present Boucherie experiment from the inlet to exit end of the pole, accompanied with an increase of arsenic proportion in the exit relative to the inlet solution, would need further investigations.

Conclusions

Overall preservative absorptions attained in tree guard poles both by sap-

displacement and Boucherie processes have been found to be satisfactory. An adverse arsenic disproportionation in the direction of movement of the preservative into the pole however occurs in both processes, leaving the central portions of the pole in the former process and the solution exit end portions in the latter process deficient in arsenic. The distribution of arsenic in the Boucherie process was however decidedly more favourable than in the sap-displacement process, with arsenic absorptions being at least ¼th of the specified levels for fence posts at the exit end portions and meeting the specified levels in the rest of the pole.

Absorptions of copper and chromium conformed to specified levels in the Boucherie unlike the sap-displacement process in which they were deficient in the central portions of the pole. The penetration of preservative in the section at various positions in the length was satisfactory in both processes.

Though the butt end of poles required to be in ground contact in tree guard poles is quite thoroughly treated even by sap-displacement, its suitability has to be decided only after service tests on tree guard poles treated by this process which have been found quite deficient in arsenic in the central portions.

SUMMARY

The results of experiment carried out on treatment of freshly felled tree guard poles of *Eucalyptus* hybrid with CCA by the sap-displacement and Boucherie processes have been described in this paper.

युकेलिप्टस हाइब्रिड की वृक्ष-सुरक्षी बल्लियो का रस-विस्थापना और बूगरी विधियों
द्वारा सीसीए उपचार करने का तुलनात्मक अध्ययन

एस०एन० शर्मा, पी०वी० कृष्णाराव वी०वी० श्रीनिवासन

सारांश

युकेलिप्टस हाइब्रिड की ताजी कटी हुई वृक्ष-सुरक्षी बल्लियों का रस-विस्थापन और बूगरी विधियों द्वारा सीसीए उपचार करने पर किये गए सनरीक्षण के परिणाम इस अभिपत्र में वर्णित किये गए हैं।

References

Anon. (1982) Code of practice for preservation of timber. IS : 401. *ISI*, New Delhi, 32 pp.

Bror Hager (1969). Leaching tests on CCA preservatives. *For Prod J.* 19 (10).

Chandra, A. and R.B. Gupta (1973) Treatment of green fence posts by non-pressure process. *J. Timb. Dev. Assoc.* (India) 23 (1) : 17-20.

Gupta, R B. and Akash Chandra (1972). Fence posts preservation by the sap-displacement method. *J. Timb. Dev. Assoc.* (India) 18 **(4)** : 5-9.

Kumar, S. and M.C. Tewari (1976). Wood poles–their deterioration, preservative treatment, inspection and maintenance in service. *J. Timb. Dev. Assoc.* (India) 19 (3).

Kuppuswamy, V. and S.N. Sharma (1986) A method to reduce sludge formation and disproportionation of solution components obtained in successive treatments of wood with CCA *J Ind. Acad. Wood Sci* (in Press).

Nagaraja Sharma, M, J C. Jain, M.C. Tewari and S.N. Mitra (1984). Studies on the distribution of wood preserving chemicals in fence posts treated by sap-displacement methods *J. Timb. Dev. Assoc.* (India), 30 **(3)** : 24 28.

Pizzi, A. (1983). A new approach to the formulation and application of CCA preservatives. *Wood Sci. Technol.* 17 : 303-319.

Pizzi, A., W E. Conradie and A. Jansen (1986). Polyflavonoid tannins–a main cause of soft-rot failure in CCA treated timber *Wood Sci. Technol*, 20 : 71-81.

Shukla, K S and A.S. Kambo (1976). Treatment of green chir poles by high pressure sap-displacement technique. *J. Timb. Dev. Assoc.* (India) 22 (3).

Tewari, M C., S N. Mitra and M. Nagaraja Sharma (1967). A note on the preservation treatment of fence posts by the sap-displacement method. *Indian For.* **93 (8)** : 535-540.

WOOD STRUCTURE OF *CLETHRA MONOSTACHYA* REHDER AND WILSON

R.D. RATURI AND R. DAYAL

Wood Anatomy Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

Clethra L. the only genus of the family Clethraceae was reported first from India by Bennet and Naithani (1978) who collected the species *Clethra monostachya* Rehder & Wilson, from Perila in Kameng District of Arunachal Pradesh at an altitude of *ca* 2300 m. The genus comprising 68 species (Airy Shaw, 1973) of small trees and tall shrubs is distributed in tropical and Eastern United States, Mexico, Central America and parts of North-western and Central-south America. In Asia it is distributed mainly in China with *ca* 15 species (Hu, 1960), although few species are found also in Malaysia. This paper describes the wood structure of *Clethra monostachya*.

Material and Methods

The anatomical description is based on the wood sample (Acc. No. 8547) collected by Bennet and Naithani. Cross, tangential longitudinal and radial longitudinal sections were cut and permanent slides prepared following the usual laboratory procedure. Tangential diameter of the vessels was measured from the cross sections, whereas measurements of fibre diameter, fibre length and wall thickness were made from macerations and are based on 100 observations each. The wood description follows the "Multilingual glossary of terms used in Wood Anatomy" (Anon, 1960).

Description

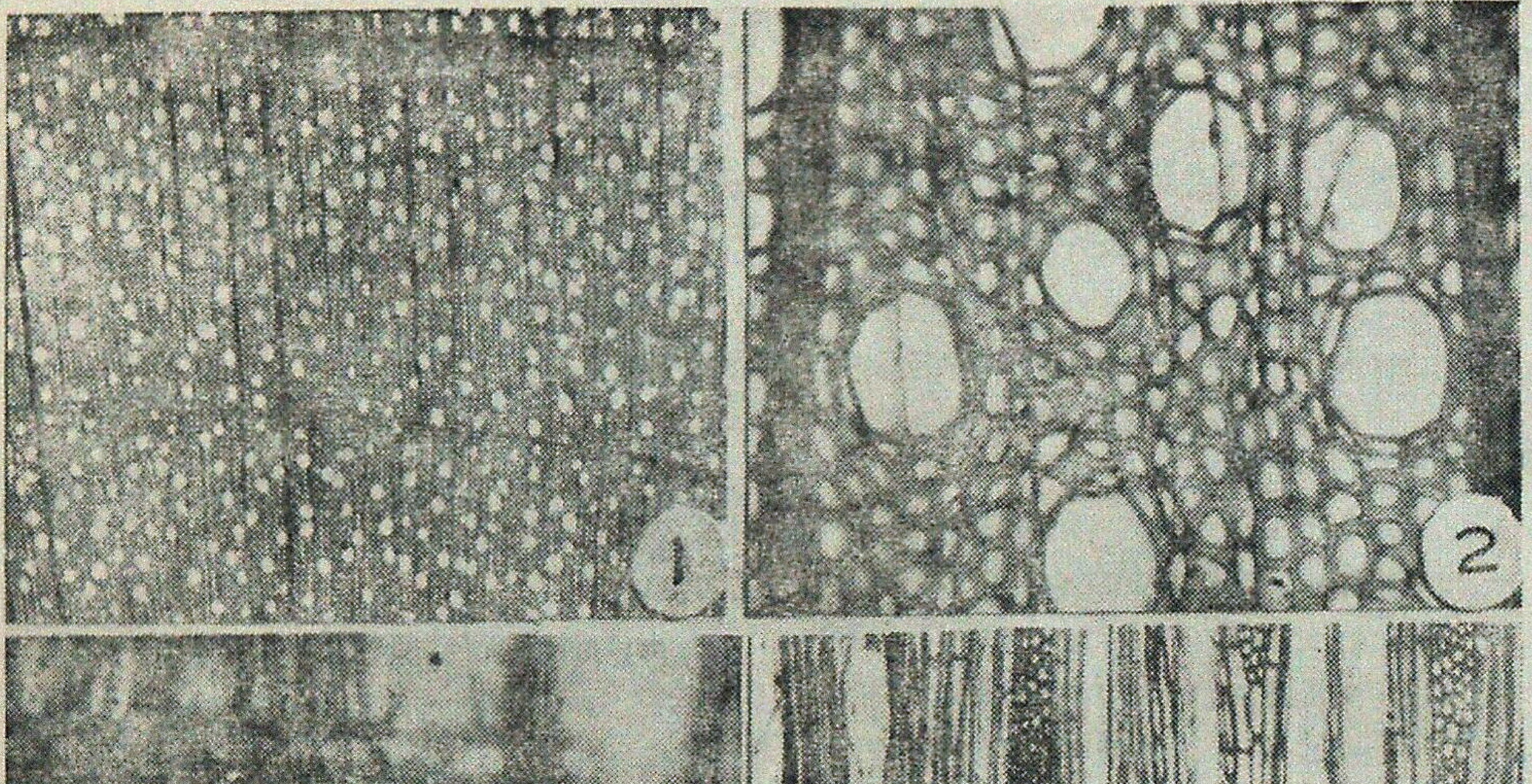
Clethra monostachya Rehder & Wilson (Pl. 1, Figs. 1-6)

General features—Wood light in colour, white when fresh but light buff on exposure, moderately hard to hard, moderately heavy to heavy, air-dry weight 710 kg/m³ (44 lb/ft³), nearly straight grained, even and fine-textured usually with lusture when fresh.

Gross structure—A diffuse-porous wood. *Growth rings* faintly visible, distinct under the hand lens on moist surface, delimited by comparatively denser fibrous tissues 4-6 per cm (Fig. 1). *Vessel/pores* small to very small distinct only under the hand lens numerous (25-35 per mm²), solitary (over 90%) sometimes in radial and tangential pairs, round to oval in outline, open; vessel lines inconspicuous on longitudinal surface. *Parenchyma/Soft tissues* indistinct to barely distinct on moist surface appearing as scattered cells. *Rays* moderately broad to fine, the former visible to the eye, distinct under hand lens, lighter in colour against the back-ground, fairly closely spaced.

Minute structure — Vessels, Mostly angular with thin walls, up to 105 μm (mean

Plate 1



Figs. (1) Cross section × 28, (2) Cross section showing angular vessel and diffuse parenchyma × 130, (3) Radial longitudinal section × 130, (4) Tangential longitudinal section × 60, (5) T.L.S. showing minute, and opposite pitting in a vessel and cells in a ray × 250, (6) R.L.S. showing scalariform perforation with numerous bars × 200.

71 μm ± 1.9 μm) in diameter; perforation plate scalariform with several thin bars (Fig. 6); intervascular pitting opposite and small (Fig. 5) 3.2 μm in diameter, pits leading to rays similar in shape and size, vessel members 616-1828 μm (mean 1276 μm±27.6 μm) in length with tails on one or both ends. *Parenchyma* apotracheal as isolated cells and short uniseriate bands scattered among the fibres (Fig. 2). *Fibres* somewhat squarish and aligned radially in cross section, average maximum diameter and wall thickness 27 μm and 5.7μm respectively; 941 μm–2280 μm (mean 1627 μm ± 33 μm) long, non-septate, with bordered pits more distinct and numerous on radial walls *Rays* 1–4 seriate, commonly 3– seriate, about 10 per mm (t), heterogeneous (Fig. 3); (i) uniseriate rays about 24 μm in width and upto 13 cells or 1360 μm in height, composed of mainly upright cells (ii) multiseriate rays upto 52 μm in width and 34 cells or 1642 μm in height, composed, of procumbent cells with one to several upright cells in the margin, sometimes two rays vertically fused forming tall rays (Fig. 4) with two multiseriate portions (t). Sheath cells occasionally present in some rays (Fig. 5).

SUMMARY

Anatomical structure of the wood of *Clethra monostachya* Rehder & Wilson of the family Clethraceae has been described.

क्लेथरेसी कुल के क्लेथरा मोनोस्टैक्या रेडर व विलसन की काष्ठ सरचना

आर०डी० रतूड़ी व आर० दयाल

सारांश

क्लेथरेसी कुल के पादक क्लेथरा मोनोस्टैवा की लकड़ी की शारीर सरचना का वर्णन दिया गया है ।

References

Airy Shaw, H.L. 1973). *A dictionary of the flowering plants and ferns* (revised 8th Ed. of the dictionary by J.C. Willis), University Press, Cambridge.

Anon. (1969). *Multilingual glossary of terms used in Wood Anatomy*, IAWA, Committee on Nomenclature, Zurich.

Bennet, S.S.R. and H.B. Naithani (1978). *Clethraceae* Klotzsch–New to Indian flora,. *Indian J. Forestry*, **1** : 189-190.

Hu, S.Y. (1960). A revision of the genus *Clethra* in China. *J. Arn. Arbor.* **41** :180.

AMENTOTAXUS (TAXACEAE)—A RARE GYMNOSPERM FROM ARUNACHAL PRADESH

K. HARIDASAN

Van Vigyan Kendra, Chessa, Banderdewa (Arunachal Pradesh)

Introduction

During the course of a botanical exploration of Lohit district, Arunachal Pradesh the author came across an interesting Taxaceae apparently looking like a *Podocarpus*. However it differed from *Podocarpus* in having white stomatal bands beneath the leaves. Detailed studies with the help of the available literature (Hook. f. 1872–1897, Kanjilal *et al.* 1934-40, Raizada & Sahni, 1960) and consultation of herbaria at Shillong (Assam), Dehra Dun (DD & BSD) revealed that the plant was not in their collections. However during the course of a reference study we came across a paper (Ferguson, 1985) wherein it is published as new species based on male plants collected from the same locality much earlier. These collections did not include female flowers and Ferguson mentions that 'Ovulate flowers and mature seeds unknown'.

Earlier collection: The plant was earlier collected only twice in 1928 by F. Kingdon-Ward and in 1874 by Lister. Lister's collection mentions the locality as Duphla Hills, the exact locality in Duphla Hills (=Dafla Hills) is not recorded by Lister. Our knowledge about *Amentotaxus assamica* is first hand and the missing information on ovulate flower is now known. There is a time lapse of over 60 years since its last collection. Considering the significance of the recollection, the species is dealt with in detail here.

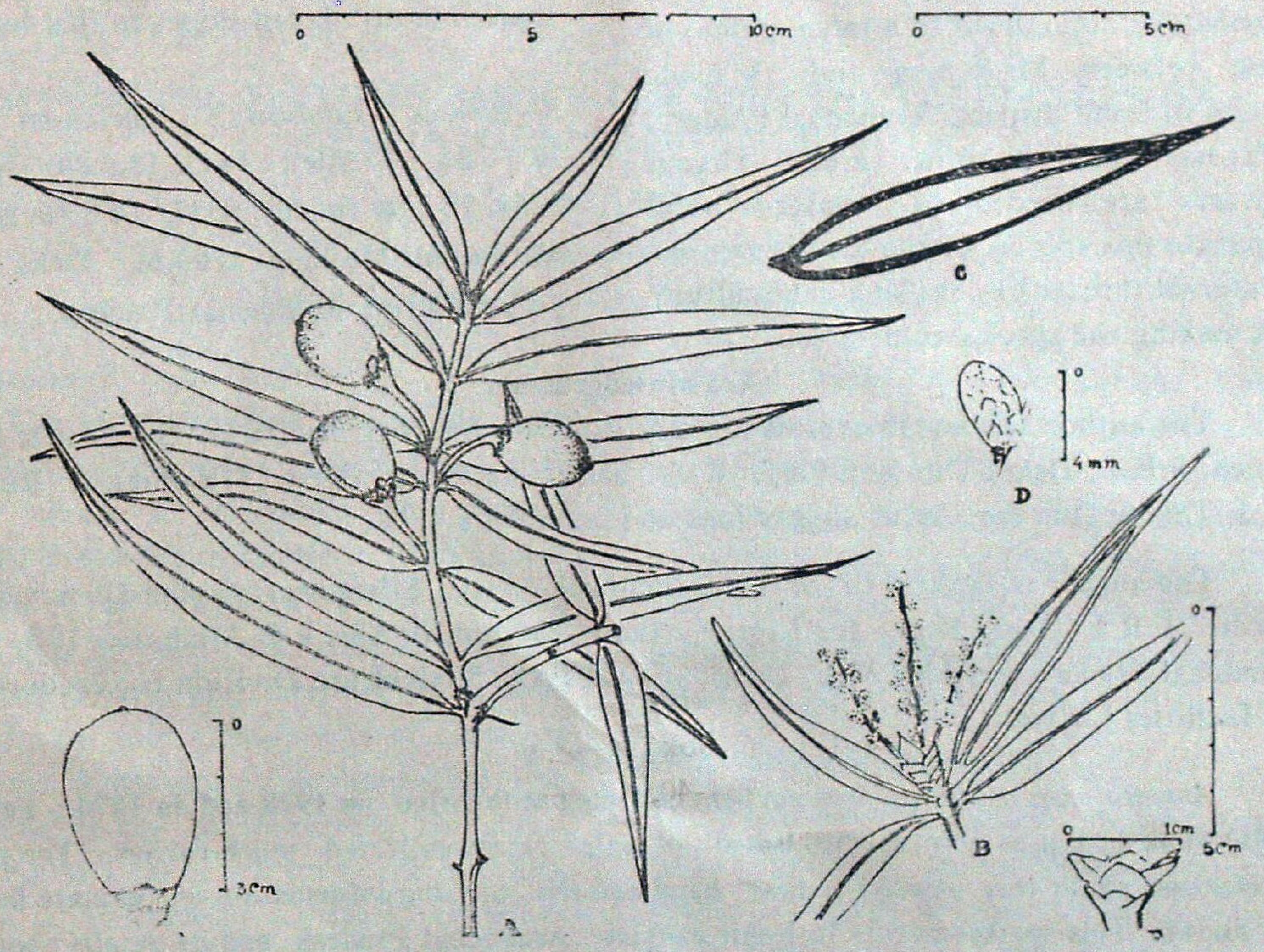
The forest where it presently occurs is although undisturbed, the practice of shifting cultivation and forest destruction is evident in adjacent areas and are fast encroaching towards this pristine forest patch. It is felt that immediate measures are to be taken to conserve this species, both *insitu* and *exsitu*, before it is too late. Suggestions are made to preserve this forest, which is known to shelter a large number of rare and interesting taxa by declaring it as a sanctuary.

For easy reference and facilitating field identification detailed description of the species, relevant notes and illustrations are provided.

Amentotaxus assamica D. K. Ferguson in Kew Bull. 40 (1) : 115–119, 1985.

Trees dioecious upto 3-8 m tall. Crown narrow conical; bark dark grey, reticulately fissured; branches whorled horizontal or drooping, branchlets slender opposite; buds ovoid angular caducous scaly. *Leaves* opposite, apparently distichous, very shortly petioled or subsessile 5–12 × 0 6-1.1 cm, linear lanceolate, linear oblong, falcate

Fig. 1



Amentotaxus assamica D.K. Ferguson : A. Twig—female plant, B. Twig—male plant, C. Leaf dorsal side, D. Male flower, E. Fruit, F. Persistant scales after fruit fall.

gradually tapering to a pointed acute apex, base cuneate, narrowed to the short petiole, dark green above, longitudinally two white lined (stomatal bands) beneath, margin entire, often slightly revolute, one nerved, mid-rib raised. *Flowers* dioecious, Male flowers yellow in terminal racemes, 4 lobed in bud and 4 per bud; stamens shortly stipitate, peltate. *Female flowers* axillary, solitary generally one in each node; scales 8, decussate, upper larger 2.5–5×2.5–5 mm ovate, keeled at back. *Fruits*. peduncled, oblong-obovoid, oblong-ellipsoid, shortly beaked at tip, shining green turning yellow to purple, 2–3.5 × 1.5–2.5 cm, one seeded. Peduncle 1.5-2.5 cm long, angular when dry. Kingdon Ward records the locality as Delie Valley, Chibaon, for his specimen *Kingdon Ward* 8026, 6 April, 1928 (holotype K).

Flowers and fruits : Fruits Aug.–Oct. : male flowers March-April.

Ecology : 1600 m to 1900 m elevation, in dense temperate broad leaved forest, associated with *Rhododendron* spp., *Castanopsis* spp., *Exbucklandia populnea*, *Quercus lamellosa*, *Magnolia* sp., *Acer* sp., *Michelia* sp., *Corylopsis himalayana*, *Carpinus viminea*, *Betula alnoides*, etc. as middle storey trees in

shade. Nearly gregarious on hill slopes.

Distribution : Confined to a large patch of forest between Mithumna and Mailang villages in Lohit district, Arunachal Pradesh, so far not found in other areas. Urgent measures are needed to conserve and propagate this species as the area is exposed to external threats like shifting agriculture, thus making the species vulnerable.

Natural regeneration : Profuse, in moist shady humus laden slopes in this locality.

Specimens examined : *Haridasan* 0113, 18 11 83 (Sterile); 1443, 18.9.84 (female); 2856, 22 3.86 (male); 3337, 14.8.86 (female) Mithumna-Mailang 1800 m. Delei valley, Lohit district, Arunachal Pradesh.

Acknowledgements

The author wishes to express his gratitude to Sri H B. Naithani, Systematic Botany Branch, F.R.I., Dehra Dun and Prof. K.C. Sahni, Director (Retd.) Biological Research, F.R.I., Dehra Dun for useful suggestions and comments.

The author is thakful to Shri B.S. Beniwal, Asstt. Silviculturist cum Documentation Officer, F R I Dehra Dun, for Library facilities and to Shri P.P. Malhotra, IFS, C.C F. Arunachal Pradesh and Shri M.L. Deori, IFS, D.F.O., Silviculture Division for encourgement and facilities for tours.

SUMMARY

Amentotaxus assamica **was earlier collected only twice on 1928 and in 1874. Fergnson (1985) published it as new species based on male plants collected much earlier. The present information about this species is first hand and the missing information on ovulate flower is now known. This species occurs in Lohit district, Arunachal Pradesh and its details about field identification, description, illustrations are given in this paper.**

एमेन्टोटैक्सस (टैक्सेसी = धनुर्वृक्ष कुल)—अरुणाचल प्रदेश से मिला दुर्लभ नग्नबीज पादक

के० हरिदासन

सारांश

एमन्टोटैक्सस असमिका इससे पूर्व केवल दो बार 1928 और 1874 म संग्रह किया गया। फर्गनसन ने (1985) बहुत समय हुए संगृहित पुंपादपों के आधार पर इसे प्रकाशित किया। प्रस्तुत जानकारी इस पादप जाति की एकदम ताजी है और इससे स्त्रीबीजजनन से पूर्व फूल की लुप्त जानकारी भी मिल जाती है। यह पादप जाति अरुणाचल प्रदेश के लोहित जिले में पाई जाती है और इसकी क्षेत्र–पहचान वर्णन और चित्रण विषयक विस्तृत जानकारी इस अभिपत्र मे दी गई है।

References

Ferguson, David K. (1985). *Kew Bulletin* 40 (1) : 115-119.

Hooker, J.D. (1872–1897). *The Flora of British India*, 7 Vols. London.

Kanjilal *et al.* (1934-40). *Flora of Assam*, 5 Vols. Govt. Press, Shillong.

Raizada, M B. and K C. Sahni (1960). Living Indian Gymnosperms Pt. I (Cycadales Ginkgoales and Coniferales) *Indian For. Rec.* (Bot.) 5 (2).

ANATOMICAL FEATURES ASSOCIATED WITH THE PRODUCTION OF GUM IN *BAUHINIA RETUSA* HAM.

S P. AGRAWAL

Wood Anatomy Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

The gum obtained from the tree *Bauhinia retusa* Ham. is known as semla gum in the trade. It resembles gum arabic obtained from *Acacia arabica* The gum is collected in the forests of Dehra Dun and Saharanpur to meet the local demand for sizing cloth, paper and may also be used as a binder in the manufatcure of Charcoal briquettes. *B. retusa* is a medium-sized tree distributed in the North-western Himalayas ascending to 1300 m in forests of Siwaliks, Eastern Uttar Pradesh, Orissa and Madhya Pradesh (Anon. 1948).

Resin or gum production in both coniferous and dicotyledonous trees is closely associated to their anatomical structure, particularly of gum canals or resin canals, their origin, development, size, frequency and distribution (Agrawal, 1973; Ghosh, 1958).

The present study has been undertaken to understand the cause of gum exudation and the anatomical features associated with it in *Bauhinia retusa*.

Material and Methods

Cambial blocks, consisting of bark, cambium and wood were collected from tapped trees during the year of tapping and during the year of rest and also from untapped trees from Ghansali and Chuna Khala Bhatta, Massoorie. Cross and radial sections of about 15-20μ were cut for microscopic studies. Different combinations of stains were used. Ruthenium red-lead acetate was found to be satisfactory for the structural clarity of gum. Photomicrographs were taken and are given in Plate 1 and 2.

Observations & Discussion

The wood is a diffuse porous; growth rings indistinct to inconspicuous. The vessels are large to medium sized, mostly open, rarely orange-brown gum is present. The parenchyma is abundant arranged in confluent bands. The rays are fine, orange-brown gummy deposits present in some cells (Rao & Purkayasthya, 1972), Plate 1, Fig 1.

In this species tapping is being done after an interval of 2-3 years, unlike many other gum yielding species and numerous cuts or blaze are made at close intervals.

The examination of cambial blocks taken out just above the blaze or cut and just below the blaze or cut from tapped trees and from untapped trees, shows that as a result of wounding the vessels in the immediate vicinity of the cambium become filled with gum; which exudes in tears (Plate 1, Figs. 3 & 4). The vessels of

untapped trees are free from gum (Plate 1, Fig. 2).

In all the gum or resin yielding trees gum/resin canals, either normal or traumatic are present (Ghosh, 1958; Ghosh & Purkayastha, 1959, 1960, 1962; Purkayastha, 1959 and Rao, 1966). These gum/resin canals not only yield gum or resin; but are also of great diagnostic value in identification of those timbers (Rao, 1966). It is interesting to note that in *B. retusa* such canals/ducts are absent.

Cambial blocks taken out from number of trees which were tapped intermittently for several years showed that only during the year of tapping the vessels are filled with gum, while the vessels of the wood formed during years when the trees were not tapped, or formed during period of rest are completely free from gummy deposits (Plate 2, Fig. 5). This shows clearly that the formation of gum takes place only due to wounding.

The cambial blocks collected at different heights from the blaze or cut and from lateral side of the blaze or cut show that the effect of wounding is very localized and not exceeding 10 cm vertically, (Plate 2, Fig. 6) and apparently not at all laterally. Numerous blaze or cut at close intervals extending to depth of about 1 cm into the wood are, therefore, necessary for tapping the tree.

SUMMARY

The anatomical studies on *Bauhinia retusa* Ham. have been carried out with particular reference to gum exudation. The observations indicate that like other gum yielding trees gum canals either normal or traumatic or gum cysts are not present in this species but the vessels near the cambium are filled with gum due to wounding and the gum exudes from these vessels in tears. The vessels formed during the year of rest are free from gummy deposits.

बौहीनिया रेटुसा मे गोंद बनने से सम्बद्ध शरीर विशिष्टताए

एस०पी० अग्रवाल

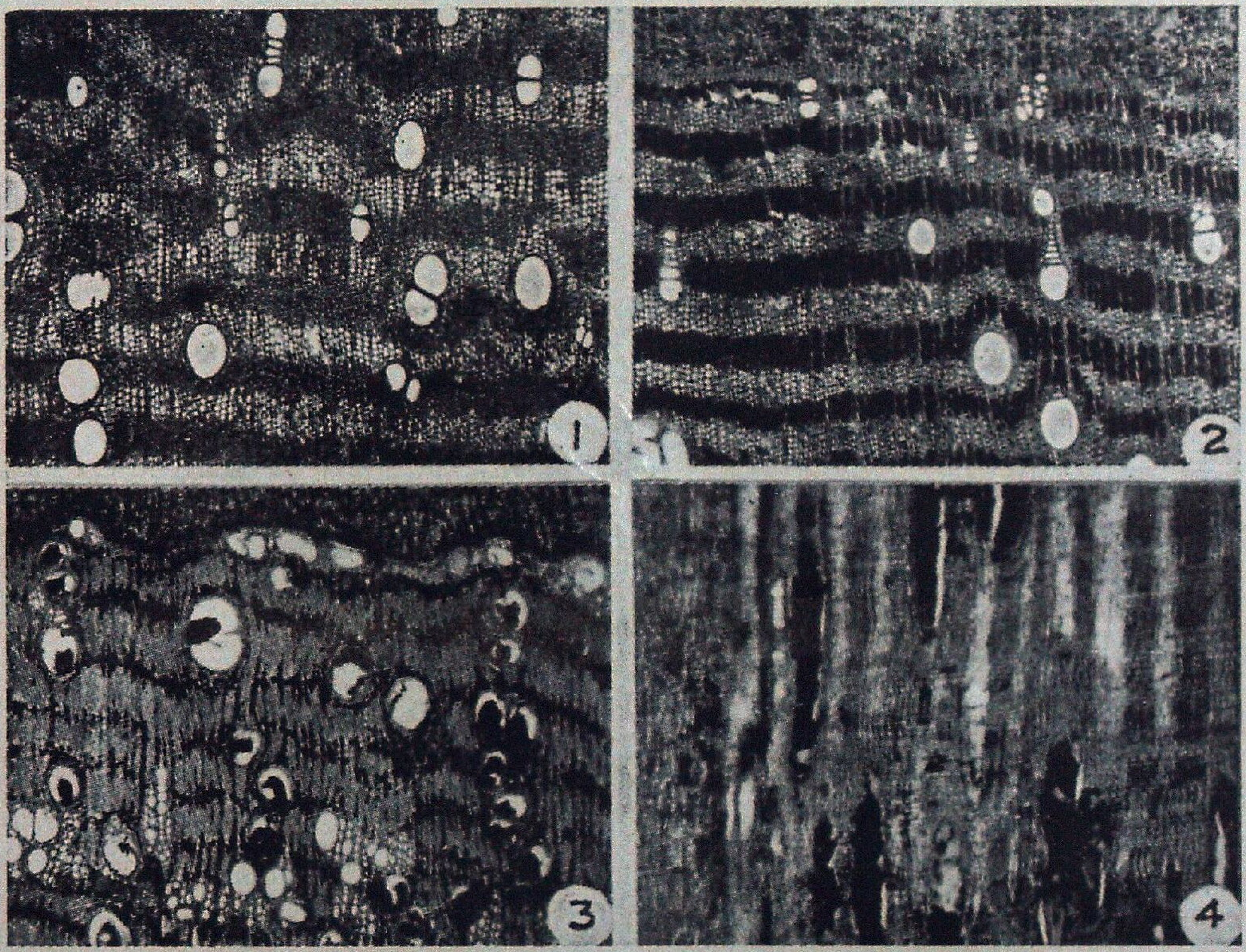
सारांश

बौहीनिया रेटुसा हैम० का शारीर अध्ययन विशेष रूप से गोंद निष्यन्दन के सन्दर्भ में किया गया। पर्यवलोकन से सकेत मिला कि अन्य गोंद देने वाले वृक्षों की भाँति इस जाति में सामान्य या जखमों से बनी गोंद कुल्या या गोंद कोष्ठ नहीं होती परन्तु जखम होने पर एधास्तर के निकट वौहिनियों में इन वौहिनियों से बूंद-बूंद निष्यन्दित होने वाला गोंद भर जाता है। विश्राम वर्ष में बनी वौहिनियों में गोदिल निक्षेप बिल्कुल नहीं होता।

References

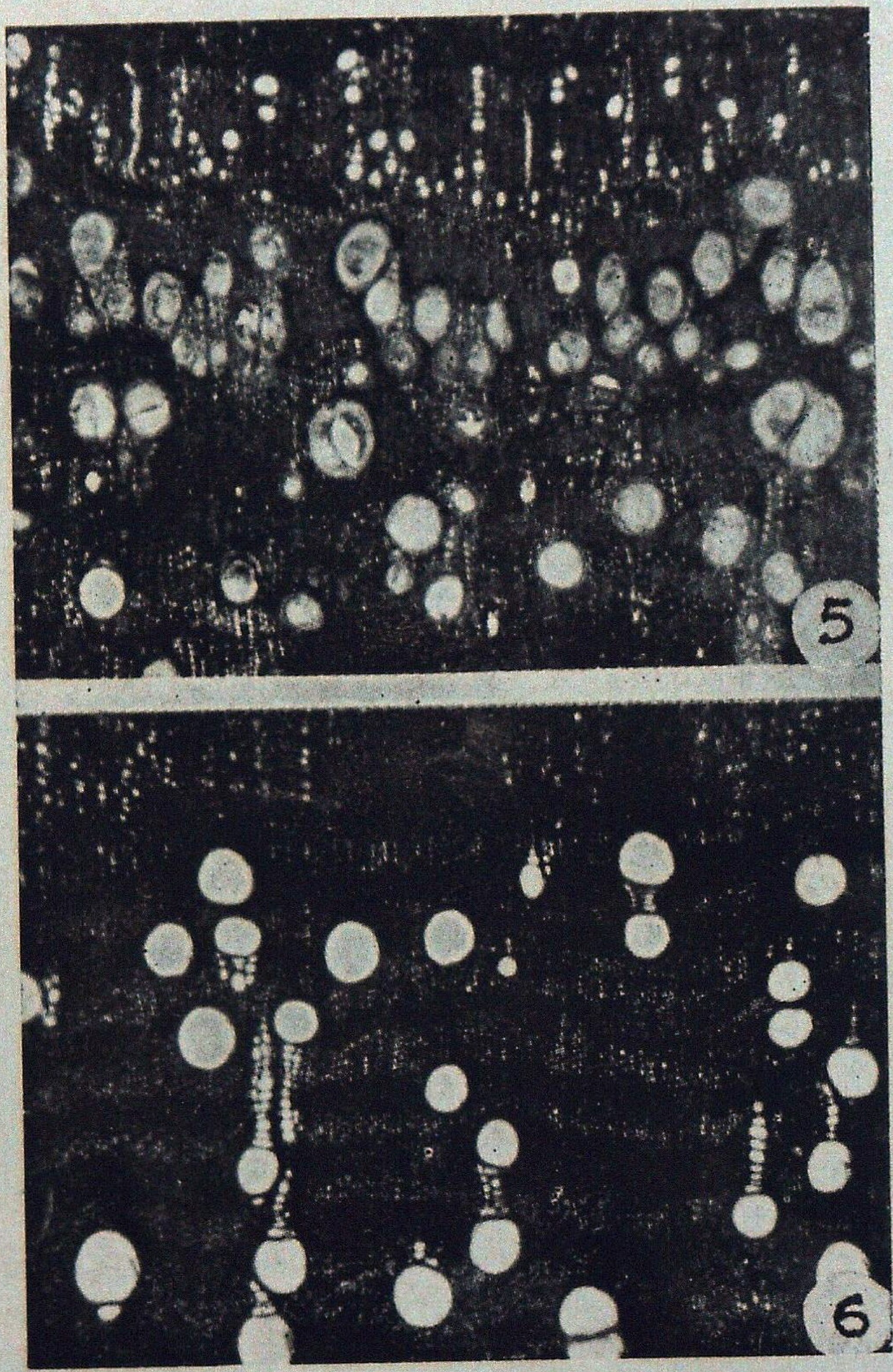
Agrawal, S.P. (1973). Variation in the size and frequency of resin canals and its influence on resin yield in Chir (*Pinus roxburghii* Sargent). *Proc. First For. Conf*, Dehra Dun, II : 680–81.

Plate 1



Figs. 1— Transverse section of wood of *Bauhinia retusa*, × 28. 2— Transverse section of cambial block from untapped tree, showing vessels free from gummy deposits; × 28. 3— Transverse section of a cambial block from tapped tree, showing vessels in the immediate vicinity of cambium filled with gum; × 28. 4—Radial section of the above showing vessels filled with gum; × 28.

Plate 2



Figs. 5— Transverse section of a cambial block from a tapped tree, showing vessels of the wood formed during the rest period smaller in size and free from gum; × 28. 6— Transverse section, of a cambial block from 10 cm above blaze, showing vessels free from gum; × 28.

Anon. (1948). The Wealth of India, **I**. CSIR, New Delhi.

Ghosh, S S. (1958). Histological responses in the secondary xylem of *Shorea robusta* Gaertn. due to tapping. *J. Scientific & Industrial Res.* **17** C (6) : 100-103.

Ghosh, S.S. and S.K. Purkayastha (1959). Preliminary observation on the exudation of gum in *Anogeissus latifolia* Wall. *Indian For.*, **85**, 437-41.

....(1960). Anatomical studies on the resiniferous system in *Boswellia serrata* Roxb. trees *Indian For.*, **86**, 684-95.

.... (1962). Anatomical studies of wood and bark of *Acacia senegal* Wild. trees, with special reference to gum exudation *Indian For.*, **88**, 92-99.

Purkayastha, S.K. (1959). An anatomical study of the effects of scarification in *Sterculia urens* Roxb. trees. *Indian For.*, **85**, 126-30.

Rao, K. Ramesh (1966). Intercellular canals in the secondary xylem and their importance in the classification and identification of Indian Woods. Tree Proceeding of the Autumn School in Botany, Mahabaleshwar, 279-94.

Rao, K. Ramesh and S.K. Purkayastha (1972). Indian Woods. Their identification, properties and uses. **III**, Manager of Publications, Delhi.

SAND MINERALS IN THE SOILS OF SOUTH KHERI FORESTS, UTTAR PRADESH

S.P. BANERJEE, A.K. RAINA AND K.C. MATHUR*

Forest Soil Vegetation Survey,
Forest Research Institute, Dehra Dun (India)

Introduction

The identification and characterization of soil minerals occupy an important place in soil studies. The basic properties of soils relevant to their use can not be properly understood without the knowledge of the mineralogical make-up. Besides, the properties of different minerals together with other soil constituents determine the soil potential (Schwertmann, 1982). Forestry scientists are especially concerned with minerals largely as a direct as also indirect source of nutrients for plants, sustained supply of which to the forest crops, especially the unfertilized ones, depends on the minerals and mineral assemblages which build up the soil and as such, much significance has been attached to evaluation of mineral reserves in soils (Yadav and Chand, 1967). Natural distribution of forest species has also been observed to be influenced by the variations in the mineralogical make-up of soils (Singh and Singhal, 1980).

The sand fractions of soils consist mostly of primary minerals which constitute a large fraction and contribute substantially to the soil bulk and hence, have considerable influence on soil properties like soil aggregation, pore space distribution, water retention and movement, soil temperature etc. to name a few. Although the importance of characterization of soil requirements of forest species is well recognized, information on the relationship between the mineralogical composition of soils, and the growth and development of forest species is rather scanty. An attempt has been made in this study to bring out the fine sand mineralogy of the alluvial soils of South Kheri forests bearing predominantly natural sal (*Shorea robusta*).

Experimental

The study was confined to the main area of the South Kheri forests with preponderance of sal (*Shorea robusta*), which is situated betweyn 28° 0′ and 28° 30′ N latitudes and 80° 16′ and 80° 35′ E longitudes. The tract lies well outside the hills in the north-eastern part of the Gangetic alluvial plain with very gentle slope to the south-east. The average elevation is 165 m above M.S.L.

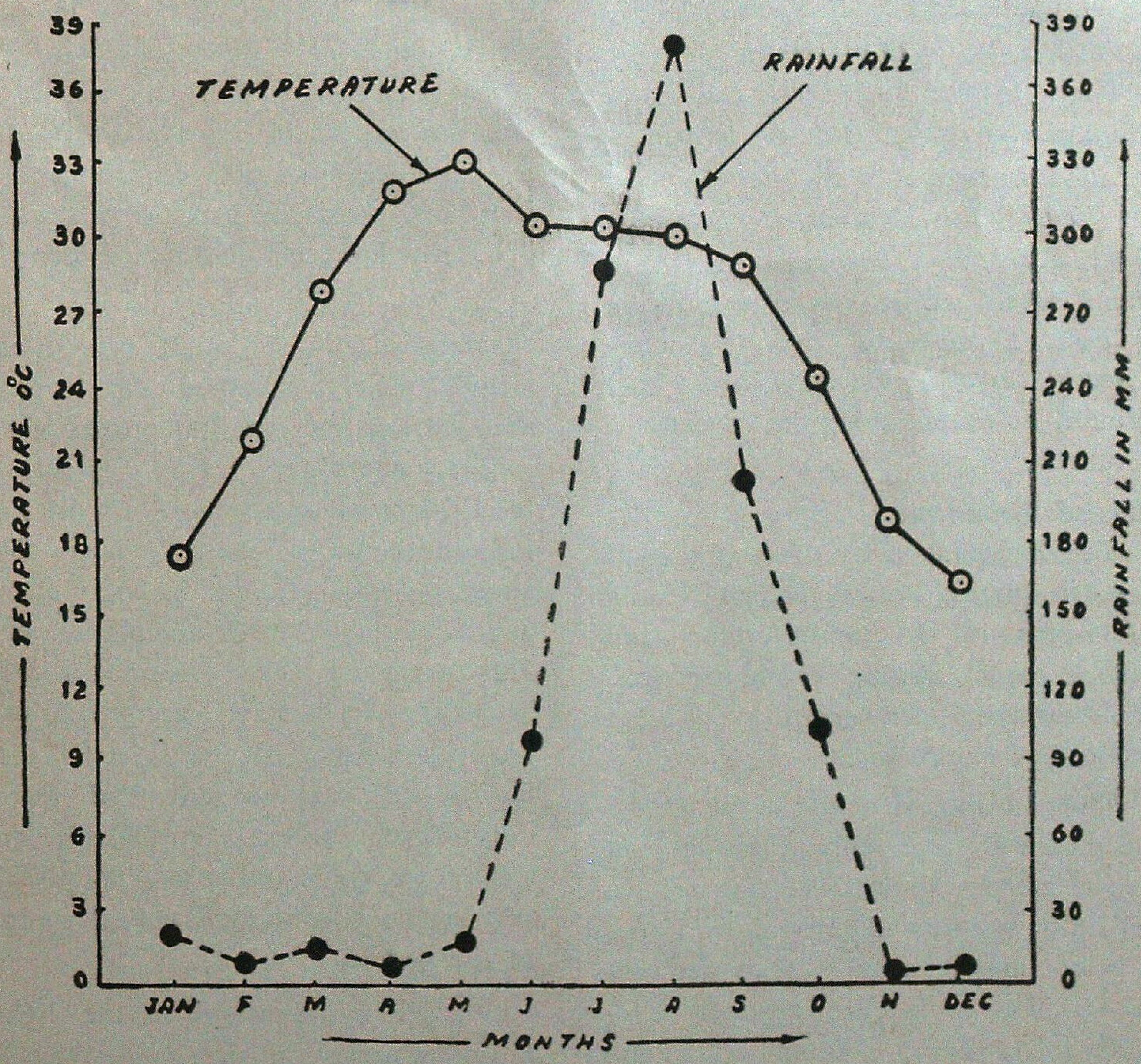
The depositional environment can be distinguished into three main divisions on the basis of differences in elevation together with the quality of soil and vege-

* Presently at K.D. Malviya Institute of Petroleum Exploration, Dehra Dun.

tation – the high, medium and low alluvial deposits, which are formed due to succession of beds in the seemingly flat terrain in the Sarda river system. The climate of the tract is one normally associated with Savanah and is represented in Fig. 1. The tract experiences extremes of temperature and humidity during different parts of the year, with frequent frosts during December and January, long and dry summer and moderate monsoon.

Several soil profiles were exposed in the study area to represent the variations in soils encountered. However, only ten such profiles which were typical of the variations were considered for the purpose of fine sand mineralogy. The sand, silt and clay fractions of the soils were separated following the procedure described by Black (1965). Fine sand was further fractionated and treated with oxalic acid to remove iron oxide coatings. Heavy and light crops

Fig. 1



Ombrothermic Diagram

were separated with the help of bromoform (Sp. gr. 2.88) and slides for heavier and lighter suites were studied with the help of petrological microscope (Leitz Labor Lux Pol 11).

Relevant data on vegetational covers around these profile sites were concurrently recorded following the method of Khan (1961) which indicated that sal (*Shorea robusta*) is the preponderent natural species occurring in continuous blocks or, at places in patches. The main associates observed were *Diospyros melanoxylon*, *Butea monosperma*, *Syzygium cumini*, *Mallotus philippinensis* with a variety of grasses to cover the forest floor. Species like *Terminalia alata*, *Lagerstroemia parviflora*, *Miliusa velutina* etc. were found in mixture with the aforesaid species. *Thermeda arundinacea*, *Erianthus ravinriae*, *Sachharum spontanium* etc. were the main species of grasses found in the study area. In addition, riverine species like *Acacia catechu*, *Dalbergia sissoo*, etc. were found to occur along the rivers and water courses.

Results and Discussion

The sand mineralogy of these alluvial soils shows quartz, micas, chlorite and a few feldspars in the lighter suites and tourmaline, garnet, zircon; apatite, iron-ores, sphene, staurolite, hornblende, kyanite and epidote in the heavier suite.

Quartz being virtually undecomposable is distinctly predominant in the sand fraction of all the horizons of the pedons. It constitutes between 50.37 and 90.22 per cent, being mostly around 65.0 per cent (Table 1). The grains are generally subrounded to rounded, contain cracks and have iron coatings, stains and iron-ores. Other inclusions are zircon, apatite etc.

Next to quartz is mica which constitutes 2.20 to 19.35 per cent with an average of 8.95 Mica, especially the muscovite type, is in higher proportion in lower depths. These well-ordered potash micas might have been inherited from sedimentary and metamorphic provenances and occur as fine flakes and shreds. Biotite is generally met with in very small quantity in all the soils, presumably due to alteration into chlorite which is found to occur in good quantity. Biotite alters more readily than muscovite and hence, is much less common in soils of recent sediments than muscovite (Pitty, 1979). Plagioclase feldspars are in traces only due to perhaps impoverishment resulting from decomposition during the abrasive transport. Feldspar usually gets destroyed due to the low relief and retarded erosion.

The heavy minerals are present characteristically in small quantities and include mainly iron-ores and tourmaline admixed with very small quantities of zircon, sphene, staurolite, apatite, garnet, hornblende, kyanite and epidote. Chlorite occurs in both the suites generally in all the soils almost uniformly along the depth and ranks approximately third in abundance (1.19 to 8.50 per cent). The iron-ores (magnetite, haematite and ilmenite) are present in some quantity in almost all the layers of the profiles, in some cases as stains and inclusions only. Zircon, garnet, hornblende, kyanite, sphene, staurolite and apatite are present in very small quantities and irregularly in most of the pedons (Table 1).

The distribution of the light and heavy minerals in the sand fractions is presented in Fig. 2. Petrographic exami-

Table 1

Minerological analysis of fine sand fractions (%)

Pedon	Depth (cm)	Quartz	Mica	Plagio-clase	Chlo-rite	Iron ores	Tour-maline	Horn-blende	Zir-con	Garnet	Sphene	Saturo-lite	Kya-nite	Epi-dot	Apa-tite
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0- 20	61.4	9.2	4.1	5 4	3.5	4.2	2 6	1.2	1.1	0.7	2.2	—	2.1	2.3
	20-180	54.7	12.1	3.1	7.5	4.9	3 2	3.2	1.1	2.6	1.2	—	2.1	3.5	0.8
2	0- 32	64.9	10.9	—	6.6	6.7	2 8	—	—	1.5	—	2.8	1.9	1.9	—
	32-120	59.7	13.5	5.5	7.7	4.7	5.3	1.4	—	—	0.5	1.5	—	—	0.2
	120-148	73.4	8.3	3 2	5.4	1.4	2.1	3.1	0.7	—	0 2	—	—	1.1	1.1
	148-180	78.6	5.9	2.8	3.7	3.6	2.8	—	—	0.4	—	—	0.6	1.6	—
3	0- 33	79 9	6 7	1.5	4.7	3.8	0.5	1.6	0.5	—	—	0.8	—	—	—
	33- 82	80.3	3.3	7.3	2.4	4.1	0.7	—	0.8	0.1	—	—	0.6	—	0.4
	82-125	78.0	5.0	6.0	3.0	3.0	0.5	0.5	1.0	0.3	0.6	0.3	0.4	0.4	1.0
	122-190	69.3	9.6	5.4	2.8	2.4	2 3	—	0.6	2.5	1.1	1.3	1.2	1.5	—
4	0- 15	69 2	10.2	5.1	5.5	3.2	2.1	—	—	1.1	—	1.2	1.3	—	1.1
	15- 46	65.1	9.1	1.1	6.1	5.1	1.1	5.0	2 1	—	1.0	2 2	1.0	1.1	—
	46- 75	65.4	7.6	6.9	5.3	2.5	—	4.7	1.5	—	—	—	3.8	2.3	—
	75-110	70 8	8.7	3.6	3.3	3.7	2.2	1.7	—	1.4	—	1.2	2,3	—	1.1
5	0- 15	59 3	19.3	3.3	6 2	4 2	4.4	—	—	1.1	—	2.2	—	—	—
	15- 45	62.0	11.0	4.2	7.0	5.1	3.2	1.2	1.1	1.1	0.7	—	2.1	1.1	0.2
	45- 81	63.2	12.1	5.0	6.0	4.1	3.1	2.2	—	—	1.0	1.0	1.1	0.5	0.7
	81-106	64.4	10.9	3.6	5.3	3.4	5.3	1.6	1.3	1.4	0.5	2.3	—	—	—
	106-170	66.1	9.0	1.0	4.1	5.1	3.5	2.1	0.1	2.1	0.7	2.2	1.0	1.0	1.0

(Contd...)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
6	0- 13	50.4	15.4	8.1	7.5	6.4	1.4	3.1	1.3	2.4	—	2.7	—	1.3	—
	13- 72	53.6	18.3	—	6.4	5.3	3.3	2.4	1.1	1.2	1.3	3.0	1.4	2.6	0.1
	72-185	54.3	20.5	—	8.2	3.4	2.4	1.3	0.1	2.9	—	3.3	—	1.3	0.3
7	0- 12	66.5	7.6	1.8	5.9	6.7	—	3.2	1.5	0.6	—	0.7	2.5	1.4	1.6
	12- 31	71.6	11.7	1.4	6.3	5.1	0.7	0.9	0.1	1.1	0.4	—	0.7	—	—
	31- 68	75.6	3.6	3.4	3.6	7.6	0.6	—	0.3	1.8	—	2.8	—	—	0.7
	68- 98	79.5	6.5	1.6	2.1	3.5	2.6	—	0.6	0.5	—	—	1.7	—	1.4
	98-139	83.9	2.7	2.5	1.6	2.4	3.9	—	—	0.6	—	1.6	—	—	0.8
	139-162	85.2	3.1	2.2	2.0	3.1	2.2	1.2	0.2	0.2	—	—	—	—	0.6
	162-185	90.2	2.2	1.5	1.2	2.1	1.2	—	0.8	—	—	0.5	—	0.2	0.1
8	0- 12	63.5	7.4	5.7	5.2	5.2	4.5	1.5	1.2	1.7	0.2	1.6	0.7	1.5	0.1
	12- 31	59.5	4.4	7.5	6.6	6.2	5.1	0.6	—	1.4	—	3.3	2.6	1.3	1.5
	31- 55	57.5	8.9	4.7	8.4	3.4	2.4	1.5	1.5	2.8	1.3	2.4	3.2	2.0	—
	55-115	60.7	9.5	5.9	7.5	2.3	3.4	—	1.4	1.6	1.8	1.3	2.3	1.2	1.1
	115-195	62.2	7.3	9.5	4.4	5.3	2.4	1.0	—	1.3	0.3	2.3	—	3.3	0.7
9	0- 14	74.3	6.5	2.8	4.5	1.3	2.5	1.3	1.2	0.7	0.6	2.1	1.1	1.1	—
	14- 41	68.6	5.5	3.4	7.8	2.6	2.4	2.3	0.6	2.3	—	1.3	2.1	1.1	—
	41- 87	75.4	6.7	—	4.7	1.7	4.9	—	—	—	—	1.6	1.3	2.3	1.4
	87-115	69.5	4.7	6.6	5.6	1.5	—	4.5	0.8	1.6	1.1	1.2	—	1.5	1.4
	115-135	68.9	5.9	3.7	4.7	0.8	3.6	1.5	1.6	2.6	0.9	—	2.7	1.5	1.6
	135-155	63.1	9.6	2.5	8.5	3.3	5.1	—	1.3	—	0.5	—	2.0	3.0	1.1
	155-190	72.1	11.1	1.2	5.1	5.1	—	1.1	1.0	0.5	0.7	1.0	1.1	—	—
10	0- 8	66.3	10.3	4.3	5.4	4.5	2.2	1.2	—	1.1	—	2.2	—	1.2	1.3
	8- 36	68.1	7.2	—	4.1	3.2	3.2	2.0	1.3	2.2	0.9	3.3	2.2	1.2	1.1
	36- 72	57.7	18.8	—	6.4	5.5	1.8	1.5	1.4	1.3	—	—	3.5	1.4	0.7
	72-134	75.4	6.3	2.2	2.1	2.2	4.3	—	0.7	0.9	0.6	2.4	1.4	1.5	—
	134-170	77.3	8.9	3.5	1.5	1.5	1.7	1.2	1.2	1.3	—	1.3	—	—	1.1

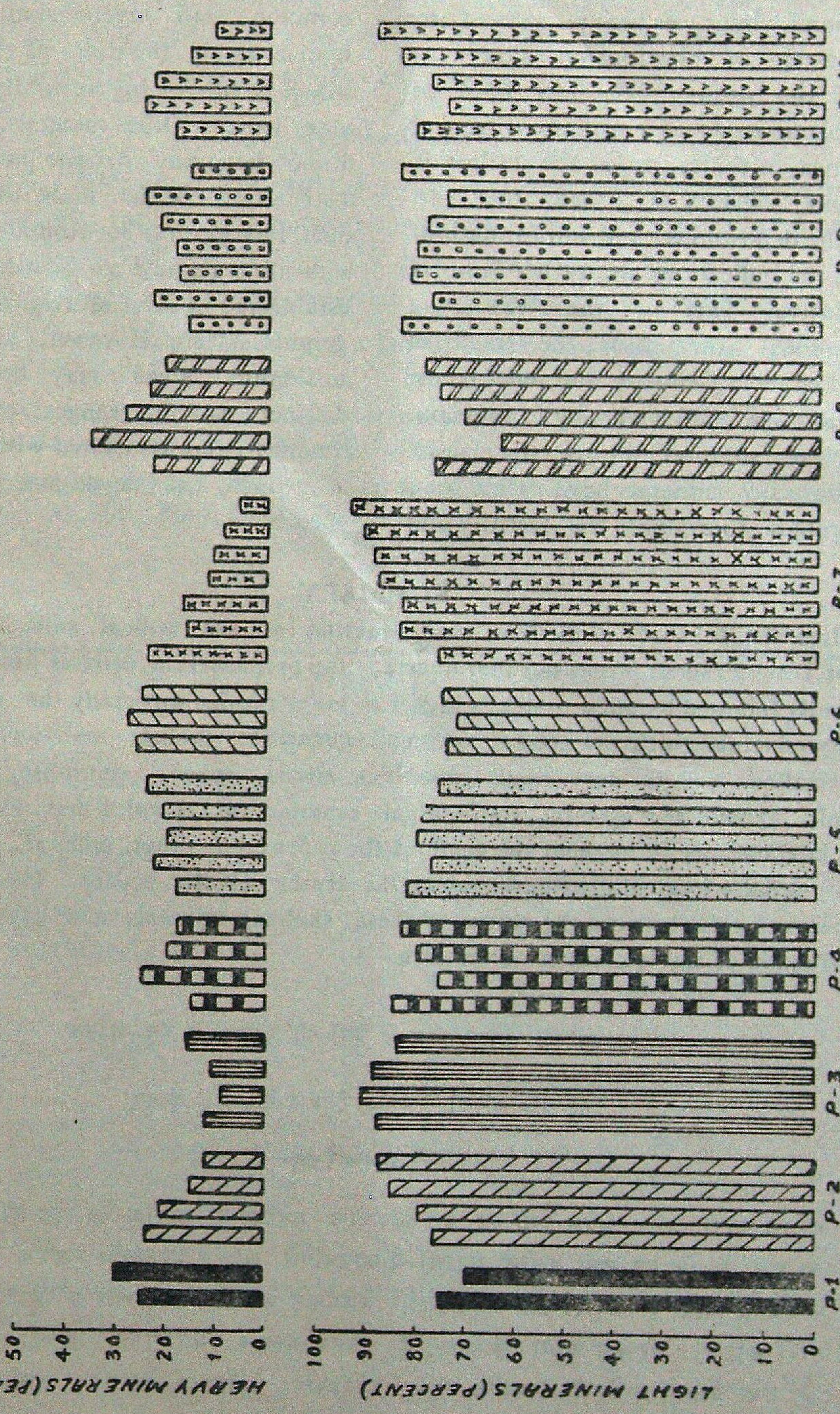


Fig. 2

Light and heavy minerals in fine sand fractions.

nation revealed that excepting quartz, no other mineral, light or heavy, showed any definite trend of distribution along the depth of the pedons. The low level of weatherable minerals such as muscovite, and near absence of feldspars, at the surface of the pedons suggests a broad time gap between the depositions and soil formation. However, the indications are rather faint to be conclusive. Due to the weathering residues, soils formed is the result of combined effects of climate and relief whose composition is affected by abrasion, alteration or solution during diagenesis. Light and heavy minerals have often been used as guides to evaluate the fertility and productivity status of the soils. The most common and overwhelming mineral is quartz in all the soils of the study area, wihch is supporting nuturally sal and some other species. Other minerals, light or heavy, do not have any definite pattern of spatial distribution in the mass of the soils. As such, relationship between any of the species with mineralogical composition could not be established in these alluvial soils of heterogenous nature. However, similar studies in analogous areas may bring out some distinct narrow ranges of mineralogical characteristics associated with varying status of growth and development of the forest species.

SUMMARY

Mineralogical study of the fine sand fraction of ten typical soils of South Kheri forests of Uttar Pradesh brings out that quartz is the preponderant detrital mineral in all these alluvial soils followed by mica which is higher in lower depths, especially the muscovite type. The heavy minerals which are present in small quantities, include mainly chlorite, iron-ores and tourmaline, and in very small quantities zircon, sphene, staurolite, apatite, garnet, hornblende, kyanite and epidote. Petrographic examination revealed that excepting quartz, which is in abundance throughout the depth of the pedons, no other mineral, light or heavy, shows any definite trend of distribution along the depths of the pedons. No definite relationship appears to exist between the nature of these skeletal minerals and growth, development and distribution of the vegetation of the area.

दक्षिण खीरी, उत्तर प्रदेश के वनों की मृदाओं के रेत–खनिज

एस॰पी॰ बनर्जी, ए॰के॰ रैना व के॰सी॰ माथुर

सारांश

दक्षिण खीरी, उत्तर प्रदेश वनों की दस प्रारूपिक मृदाओं के बारीक रेत अंश का खनिजीय अध्ययन करने से पता चला है कि इन सभी जलोढ़ मृदाओं में व्यपघर्षित खनिज प्रमुखतया स्फटिक (क्वार्टज) है जिसके बाद कम में अबरक आता है जो निचली गहराइयों, विशेषकर मास्कोवाइट प्रकार की मृदाओं में, अधिक पाया गया है। भारी खनिज, जो कम कात्रा में मिलते हैं, उनमे मुख्यज: क्लोराइट, कच्चा लोहा और टूरमैलीन सम्मिलित हैं तथा अत्यल्प मात्रा में जिरकोन, स्फेन, स्टैरोलाइट, एपेटाइट, गारनेट, हार्नब्लेण्ड, क्यानाइट और एपिडोट हैं। शैल विज्ञानी जांच से पता लगा है कि क्वार्टज को छोड़कर जो मृदा की पूरी गहराई में सर्वत्र

प्रचुरता में मिलता है, कोई भी अन्य भारी या हल्का खनिज मृदाओं की गहराई में किसी विशेष प्रवृत्ति से वितरित हुआ नहीं पाया जाता। इन ककार्लय खनिजों की प्रकृति और इस क्षेत्र की वनस्पतियों की वृद्धि, विकास और वितरण में कोई निश्चित सम्बन्ध हो. ऐसा नहीं पाया जाता।

References

Black, C.A. (1965), *Methods of Soil Analysis.* Am. Soc. Agron. Inc. Madison, U.S.A.

Khan, M.A W. (1961). Methods of studying forest types. *Proc. X. Silva. Conf.* held at FRI & Colleges, Dehra Dun. pp : 114–119.

Pitty, A.F. (1979). *Geography and soil properties.* University Press. Cambridge.

Schwertmann, U. (1982). Soil mineralogy : a key to understand soils. *Trans. 12th Int. Cong. Soil Sci.* New Delhi, India.

Singh, S. and R.M. Singhal (1980). Sand mineralogy of some forest soils of outer Himalayas. *Van Vigyan,* 18 (1-2) : 10–14.

Yadav, J.S.P., and Gulab Chand (1967). Need for mineralogical analysis of forest soil. *Proc. XI Silva. Conf.* Dehra Dun. 215-223.

FORM IV

1.	Place of Publication	—	New Forest, Dehra Dun.
2.	Periodicity of its publication.	—	Monthly.
3.	Printer's Name	—	S.K. Arora
	Whether citizen of India	—	Yes
	Address	—	Print World, Anekant Place, Dehra Dun.
4.	Publisher's Name	—	B.S. Beniwal
	Whether citizen of India	—	Yes
	Address	—	P.O. New Forest, Dehra Dun.
5.	Editor's Name	—	G.P. Maithani
	Whether citizen of India	—	Yes
	Address	—	P.O. New Forest, Dehra Dun.
6.	Names and addresses of individuals who own the newspaper and partners or share holders holding more than one per cent of the total capital.	—	The Board of Management, Indian Forester, P.O. New Forest, Dehra Dun.

I, B.S. Beniwal hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd./- B.S. Beniwal
Signature of Publisher

CHEMICAL CHARACTERISATION OF *OLEA DIOICA* ROXB. SEED OIL

P.P. JAIN, N.P. DOBHAL AND K.S. AYYAR

Chemistry of Forest Products Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

Olea dioica Roxb. a medium sized mostly dioecious tree, usually about 18 m in height but sometimes reaching upto 30 m, is found in the Eastern Himalayas, Duars, Assam and in Deccan Peninsula, chiefly in Western Ghats The tree is also planted for shade. It is reported to possess a fairly fast rate of growth with a mean annual girth increment of c-3 19 cm. The wood has a sweet scent when freshly cut and is, therefore, known as "Rose Sandalwood" in Bombay. The wood is used in Assam for domestic purposes; it is suitable also for carving and cabinet work. The fruit is bitter to taste. The bark is reported to be used as febrifuge; in Queensland, it is reported to be an emetic. The leaves (nitrogen content 1.14%) may be used as green manure (Anon., 1966).

Materials and Methods

The mature seed of *Olea dioica* Roxb. were received from Maharashtra. After removal of testa, the kernels were powdered and extracted in a soxhlet apparatus with petroleum ether (60-80°) to get the oil. Physico-chemical constants of the oil were determined according to the standard methods (Anon., 1973). The seed oil was saponified for 12 hrs with ethanolic potassium hydroxide solution and unsaponifiable matter was removed from the soap solution by extraction with ether. Fatty acids were isolated from the soap solution by usual method and converted into their methyl esters by refluxing with methanol in the presence of concentrated sulphuric acid.

The mixture of the methyl esters was analysed using a CIC Gas chromatograph fitted with FI detector and 20% butanediol succinate polyester on celite 545 (4 ft) column. The column temperature was kept under programming from 140° to 220° (2° per min. being the rise in temperature) and nitrogen (40 ml/min) was used as the carrier gas.

The peaks were identified by comparison with the retention times of the reference compounds under the same conditions and by peak enhancement method. The peak area percentages were considered as weight percentages.

Results and Discussion

The kernels (48.8% of seeds) were found to contain 24.54%of a fixed oil which possesses the following physico-chemical properties :

Refractive index	—	1.4369/25°C
Acid value	—	42.35
Saponification value	—	208.97
Iodine value	—	87.67

Methyl esters of mixture of fatty acids obtained by the hydrolysis of seed fat, had the following composition as shown by its gas–liquid chromatographic analysis:

Palmitic (16 : 0)	—	24.10
Arachidic (20 : 0)	—	7.93
Behenic (22 : 0)	—	0 77
Oleic (18 : 1)	—	41.45
Linoleic (18 : 2)	—	15 04
Others (unidentified acids)	—	10.71

The kernel of the seed is rich in oil (24.54%). Also kernels constituting 48.8% of the seed can be separated by simple decortication by hammering. Therefore, seeds can be commercially exploited. The oil is rich in oleic and linoleic acids (56.49%). So if it is non-toxic, it can be used as a good edible oil.

Acknowledgements

The authors express their thanks to Shri M.G. Gogate, Conservator of Forests, Nasik, Maharshtra for supplying the seeds and the plant materials for identification and Shri P.C. Gupta, Systematic Botany Branch, Forest Research Institute, Dehra Dun, for identifying the plant. They are also grateful to the Director, Silviculture Research, for his constant encouragement throughout the investigation.

SUMMARY

The kernels (48.8% of seeds) of *Olea dioica* Roxb received from Nasik (Maharashtra) yielded 24 54% of a fixed oil, having refractive index, 1.4369/25°C; acid value, 42.35, saponification value, 208.97 and iodine value, 87.67. Gas-liquid chromatographic analysis of the mixed acids has shown the fatty acid composition as palmitic, 24.10%; arachidic, 7.93%; behenic, 0.77%; Oleic, 41.45%; linoleic, 15.04% and others (unidentified acids), 10.71%. The seed oil may be recommended for edible use after ascertaining its non-toxic nature.

ओलिया डायोइका राक्स० के बीजों के तेल का रासायनिक गठन निश्चित करना

पी०पी० जैन, एन•पी० डोभाल व के०एस० अय्यर

सारांश

ओलिया डायोइका राक्स० नासिक (महाराष्ट्र) से प्राप्त हुई गिरियों (बीजों का 48.8%) से 24.54% न जनने वाला तेल निकला जिसका भुजायनांक 1.4369/25° से०, अम्ल अर्हा 42.35, साबुनीकरण अर्हा 208.97 और आयोडीन अर्हा 87.67 थो । मिश्र अम्लों क गैस-द्रव वर्णमापिकी विश्लेषण ने दिखाया कि वसा-अम्लों का गठन पामीटिक 24.10%, एराकिडिक 7.93%, बेहेनिक 0.77%, ओलिइक 41.45%, लिनोलिइक 15.04% और अन्य (अनपहचाने अम्ल) 10.71% है अमादक प्रवृति को मालूम करने के बाद यह बीज तेल खाने के लिए उपयोगार्थ अभिस्तावित किया जा सकता है ।

References

Anon., (1966). *Wealth of India*–Raw Materials, CSIR, New Delhi, Vol. VII, p. 91.

.........(1973). Official Standardized and Recommended Methods (2nd ed.), Society of Analytical Chemists, A.O.A.C, London, 675.

ON THE BIOLOGY OF *STERCULIA URENS*, ROXB. (KULLU) DEFOLIATOR *OGLASA SEPARATA* WALKER (LEPIDOPTERA : NOCTUIDAE)

H.R. KHAN, LALJI PRASAD AND SUSHIL KUMAR

Forest Entomology Branch,
Forest Research Institute, Dehra Dun (India)

Introduction

Sterculia urens Roxb. (Kullu) is one of the most valuable gum yielding tree species of Madhya Pradesh, India (Anonymous, 1973). The tree is attacked by several insect species viz. *Sylepta balteata* (Lepidoptera : Pyralidae), *Nephopterix* sp. (Lepidoptera : Pyralidae) and *Batocera rufomaculata* (Coleoptera : Cerambycidae) reported by Amin and Upadhyaya, 1977 ; Beeson, 1941; Brown, 1968. Apart of these insect species, the tree is also defoliated by *Oglasa separata* Wlk. Hitherto, its biology and life history is not studied, hence it is first Indian record. The larva has been described by Gardner (1948). In Madhya Pradesh, *O. separata* considerably defoliated the Kullu plantations at Jabalpur and adjoining areas in 1984 and 1985. The studies were carried out in Disease Insect Survey laboratories, R.F.R.C., Jabalpur, Madhya Pradhesh.

During field trips at Jabalpur, Seoni and Khandwa in Madhya Pradesh immature stages of insects were collected during June and July and reared in laboratory and insectary cages. A record was maintained about its life history.

Nature of damage : Larvae feed on the parenchymatous tissue of epidermal layers from the leaf margin. Later on, they may consume whole green leaf except midrib and larger veins (Fig. 2). Five to eight larvae were observed feeding on the same leaf at a time.

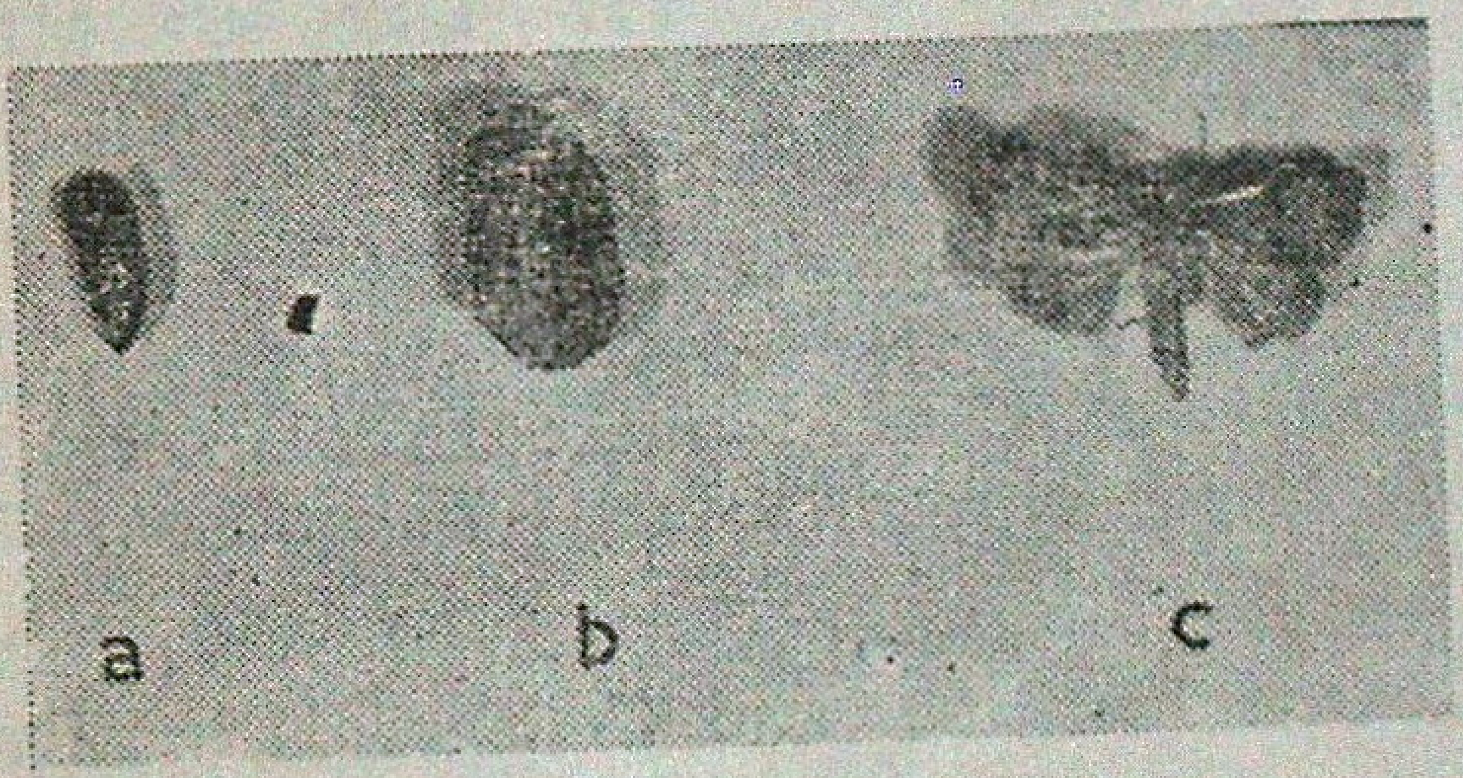
Life history : *Oglasa separata* completes its life cycle in 43 to 60 days during July and August. However, low infestation starts from March-April. It complete 3 to 4 overlapping generations in a year. The details of the various stages of the insect are given below.

Moth : Moth is medium sized, light brown with dark pubscence on the thorax, fore wings with blackish patches at costal areas, hind wings brownish, apical portion with scales. Wing expanse is 30 to 35 mm (Fig. 1 c). The adult's longivity was recorded 5 to 8 days during July.

Eggs and oviposition : Eggs are whitish yellow, globular in shape, and 1 mm in diameter. The aggs are laid singly on the lower surface of the leaves. Oviposition takes place during day time. A female can lay up to 25 eggs in a day and upto 158 in her whole life period. Eggs take 5 to 8 days to hatch.

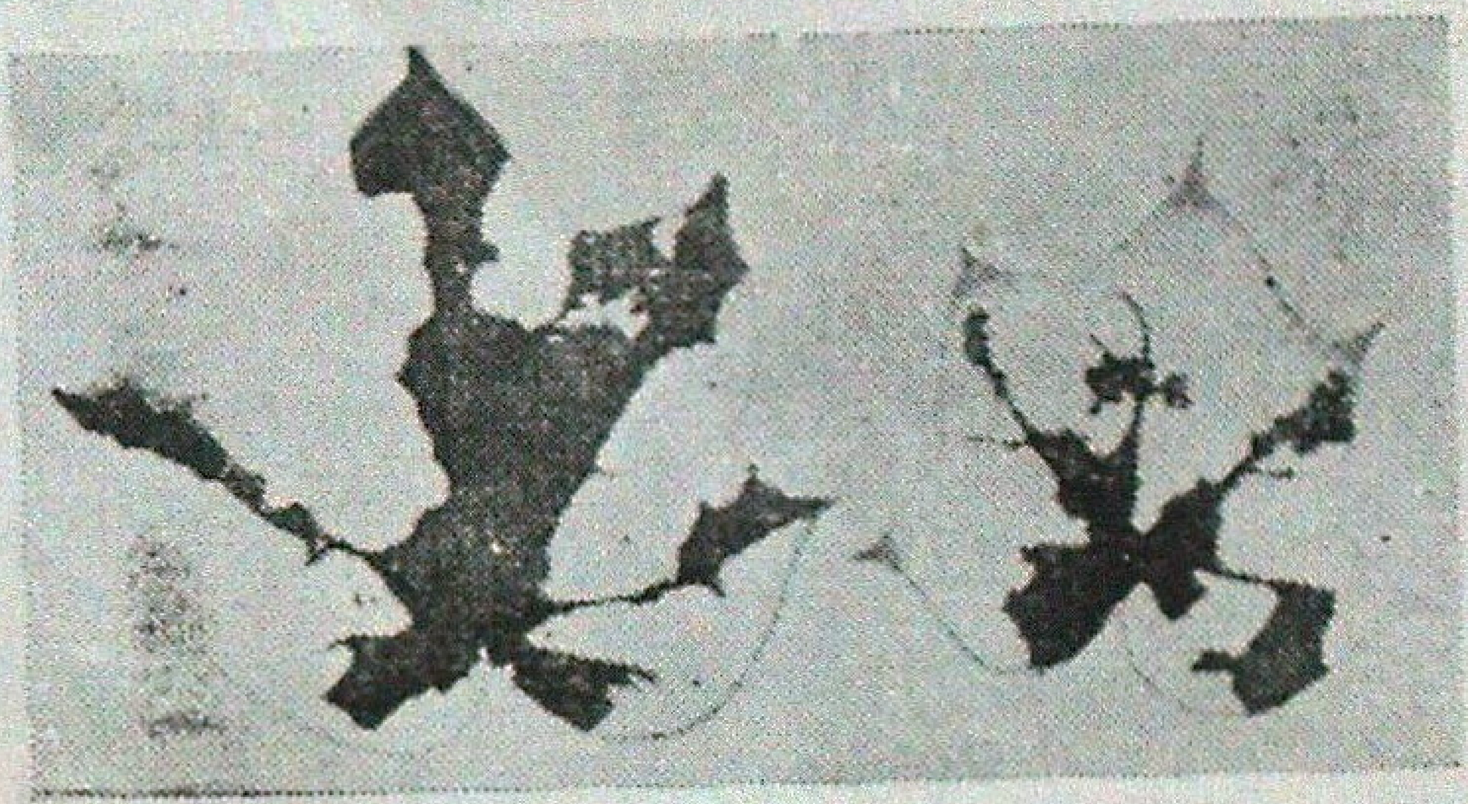
Larva : Freshly hatched larva is light green in colour and changes to yellowish brown at mature stages. Larva moults 5 times during larval period Head is yellow with

Fig. 1



Life stages : Kullu defoliator *Oglasa separata* walk.

Fig. 2



Damage to leaves of *Sterculia urens* (Kullu) by *Oglasa separata* Walk.

5 black dots showing white colour stripes dorsally on each side along with whitish spot on the dorsal and lateral sides of the body. Legs are black, prolegs and spiracles are pale. The fully grown larvae measured from 40 to 50 mm. The larval period was recorded 20, 25 days.

Pupa : During pupation, larva contracted in size and changes into pink colour. It dropped off from the leaf on the soil and pupation occurs inside the soil below 1 to 3 cm from soil surface in a cocoon, made by entangling the faecal matter, litter etc. with its saliva (Fig. 1 b). Pre-pupal and pupal period was recorded 3 to 4 days and 10 to 15 days respectively. Pupa is reddish brown in colour, measured 10 to 15 mm in length and 3 to 4 mm in width. Spiracles were visible (Fig. 1 a).

Acknowledgement

Authors are thankful to Divisional Forest Officers of Khandwa and Seoni Forest Divisions (M.P.) for providing facilities during field studies.

SUMMARY

Defoliation of *Sterculia urens* (Kullu) trees by *Oglasa separata* Walker was recorded in Madhya Pradesh. Biology of defoliator was studied. The insect completes its life cycle from 43 to 60 days during July and August. Larval and pupal period was recorded 20 to 25 and 10 to 15 days respectively.

स्टेकूलिया यूरेंस राक्स० (कुल्लू) के निष्पत्रक कीट ओग्लासा सेपेरेटा वाकर (शल्किपक्षा : नेक्कुइडी) की जैविकी के सम्बन्ध में

एच०आर० खान लालजी प्रसाद व सुशील कुमार

सारांश

ओग्लासा सेपेरेटा वाकर द्वारा कुल्लू (स्टैरकूलिया यूरेंस) की पत्तियों का विनाश मध्यप्रदेश से अभिलिखित किया गया। इस निष्पत्रक कीट की जैविकी का अध्ययन किया गया। यह कीड़ा अपना जीवन

चक्र जुलाई और अगस्त के महीनों में 43 से 60 दिनों में पूरी करता है। इसकी जातक और कोशित अवस्थाएं क्रमशः 20 से 25 और 10 से 15 दिनों तक की अभिलिखित की गई।

References

Amin, P.W. and A.K. Upadhaya (1977). *Sylepta balteata* F. (Pyralidae : Lepidoptera) an important pest of Kullu, *Sterculis urens* (Sterculiaceae). *Indian For.*, **103** (7) : 480--482.

Anonymous (1973). (Gum Karaya) Forest Research Institute and Colleges, Dehra Dun, Publication No. 7, Industrial series.

Beeson, C F.C. (1941). *The ecology and control of the forest insects of India and neighbouring countries.*, Vasant Press, Dehra Dun (Govt. of India Publication, New Delhi) 525 pp. (Reprint 1961).

Brown, F.G (1968). *Pest and disease of forest plantation trees.* Clarendon Press, Oxford. 133 pp.

Gardner, J.C.M. (1948). On the larvae of the Noctuidae (Lepidoptera IV). *Trans. R. Ent. Soc.* London **99** : 291-318.

EFFECT OF MOISTURE STRESS ON SEED GERMINATION OF SPRUCE

VIRENDRA SINGH AND G.S. PALIWAL*

Conifers Research Centre, Shimla (Himachal Pradesh)

Introduction

Spruce (*Picea smithiana*) seeds are dispersed in October and November. The peak dispersal period of the seed vary between 13th October to 24th November (Singh and Singh, 1984 a). The seed of spruce get buried under the snow just after dispersal. The germination of dispersed seed commences with the onset of monsoon rains in the later part of June and continue during July and August (Singh and Singh, 1984 b). As the germination of the spruce seed starts in the later part of June, the dispersed spruce seed get sufficient moisture at the time of snowmelt and then are subjected to dry period in May and thus the seeds of spruce are subjected to wetting and drying and consequent moisture stress. Several workers have studied the effect of moisture stress on seed germination of different species (Farmer and Bonner, 1967; Bonner, 1968; McWilliams *et al.*, 1970; McDonough, 1979; Cluff *et al.*, 1983; Everitt, 1983 a and b; Everitt *et al.* 1983; Singh and Singh, 1983). The effect of moisture stress on germination of spruce seed has, however, not been investigated and therefore, the present study was undertaken accordingly.

Materials and Methods

Spruce seed was collected from the natural forests of silver fir and spruce falling under Kotgarh Forest Division, Himachal Pradesh. The solutions of different moisture stresses were prepared by dissolving polyethylene glycol (PEG) according to the method suggested by Zur (1966) for applying the different levels of moisture stress to the seed. The solutions of different osmotic potential applied to the seed were 0.0, –0.5, –1.0, –1.5, –2.0 –2.5, –3.0, –5.0, –6.0 and –7.0 atm. Distilled water was used in control. The germination tests were carried out by employing the method of Singh and Singh (1981). The seeds were placed on moist filter paper in petridishes and kept in BOD incubator at 20°C. The filter paper was made moist with solutions of different concentrations of polyethylene glycol and distilled water, according to the treatment, and were added at regular intervals to keep the filter paper moist. Four hundred seeds in each treatment divided into 4 replicates were used. Germination count was taken daily after the commencement of germination till it was over. Protrusion of radicle was taken as the criterion of germination.

---

* Department of Botany, University of Garhwal, Srinagar (U.P.)

From the daily germination counts, the germination values were calculated using the method of Czabator (1962). Statistical analysis of the data of germination percentage was carried out after "Arc sine" transformation.

Results and Discussion

Germination percentage and germination value of spruce seed as affected by different levels of moisture stress is presented in Table 1.

The results show that the germination percentage decreased as the levels of moisture stress increased, but the germination percentage under the moisture stress of –0.5 atm was not significantly different from control. The germination under the moisture stress of –1.0 atm was significantly different from control and for remaining treatments, but was not significantly different from the germination per cent obtained under the moisture stress of –0.5 atm. The germination percentage under the moisture stress of –2.0 atm did not differ significantly at 1% level from the germination under the moisture stress of –1.5 atm and –2.5 atm. The germination under the moisture stress of –3.0 atm was significantly different from that under the moisture stress of –5.0, –6.0, –7.0 atm but was not significantly different (1% level) from seed germination obtained under the moisture stress of –2.5 atm.

The trend of differences in respect to the germination values was similar to that of germination percentage.

The results of the present study are in agreement with those of Farmer and Bonner (1967) who reported that the germination energy of eastern cotton wood seed gradually decreased as the moisture stress increased from –10 atm; moisture stress of –15 atm inhibited the germination except at

Table 1

Germination of Picea smithiana seed as affected by different levels of moisture stress

Moisture stress (atm).	Germination percentage	C.D.	Germination value
–0.0 (Control)	34.50 (35.97)	2.77 at 5%	3.33
–0.5	31.75 (34 30)	3.74 at 1%	3.04
–1.0	27 25 (31.47)		2.87
–1.5	21.25 (27.45)		2 87
–2.0	18.50 (25.48)		2.01
–2.5	15.50 (23.19)		1 81
–3.0	13.00 (21.13)		1.31
–5.0	6.00 (14.18)		0.32
–6.0	2.25 (8.61)		0.00
–7.0	0.25 (2.87)		0.002

Figures in brackets are the transformed values of germination percentages.

high germination temperature. Mc Donough (1979) reported the significant decrease in seed germination in *Populus tremuloides* at −2.3 atm and none of the seed germinated at a moisture stress of −7.7 atm. Singh and Singh (1983) also found that the seed germination of *Populus ciliata* decreased as the moisture stress increased from 0 to −3.0 atm and seed germination was found to be 3 0 per cent at a moisture stress of −3.0 atm as compared to 73.0 per cent in control. Singh *et al.* (1986) also reported that the germination of silver fir seed decreased as the moisture stress increased in silver fir. The seed germination was only negligible (1.25%) at a moisture stress of −7.0 atm.

SUMMARY

The results of the experiment conducted to study the effect of different levels of moisture stress indicated that the germination of spruce seed decreased as the moisture stress increased. The seed germination was 0.25% only at a moisture stress of −7.0 atm. Even the slighest moisture stress of −0.5 atm tended to decrease the seed germination, but the decrease in germination under the moisture stress of −0.5 atm was not significantly different from control,

प्रसरल (स्प्रूस) के बीजो के अकुरण में आर्द्रता पर पड़े दबावों का प्रभाव

वीरेन्द्र सिंह व जी०एस० पालिवाल

सारांश

आद्रता के दबावों के विभिन्न स्तरों के प्रभाव का अध्ययन करने के लिए किए संपरीक्षण के परिणामों ने संकेत दिया है कि जैसे-तैसे आद्रता का दबाव बढ़ता गया, प्रसरल के बीजो का अकुरण घटता गया। आद्रता का दबाव 7.0 एट्म रहने पर बीजों का अंकुरण केवल 0.25% रह गया। यहां तक कि आर्द्रता के दबाव मे मामूली सी वृद्धि -0.5 एट्म होने से ही बीजो का अकुरण बढने लगा, परन्तु -0.5 ऐट्म आर्द्रता दबाव होने पर अंकुरण में हुई घटत तुलना मे नियामक की घटत से सार्थक अन्तर वाली नहीं थी।

References

Bonner, F.T. (1968). Water uptake and germination of red oak acrons. *Bot. Gaz* **129** : 83-85.

Cluff, G.J., R.A. Evans and J.A. Young (1983). Desert salt grass seed germination and seed bed ecology. *J. Range Manage.* **36** : 419-422.

Czabator, F.J (1962) Germination value : an index combining speed and completeness of pine seed germination. *For. Sci.* **8** (4) : 386-396.

Everitt, J.H. (1983 a). Seed germination characteristics of three woody plant species from South Texas. *J. Range Management*, **36** : 246-249.

................(1983 b). Seed germination characteristics of two woody legumes (retama and twisted acacia) from South Texas. *J. Range Management*, **36** : 411-414.

Everitt, J.H., M.A. Alaniz and J.B. Lee (1983) Seed germination characteristics of *Kochia scoparia* *J. Range Management*, **36** : 646-648.

Farmer, R.E. Jr. and F.T. Bonner (1967). Germination and initial growth of eastern cottonwood as influenced by moisture stress, temperature and storage. *Bot. Gaz.* **128** (3-4) : 211-215

McDonough, W.T. (1979). Quaking aspen seed germination and early seedling growth. USDA *For. Serv. Res. Paper INT—234* : 1-13.

McWilliams, J.R., R.J. Clements and P.M. Dowling (1970) Some factors influencing the germination and early seedling development of pasture plants. *Aust. J. Agric. Res.* **21** : 19-32.

Singh, R.V. and Virendra Singh (1981). Preliminary studies on the quality of Spruce and Silver fir seed as affected by its source. *Indian For.*, **107** (9) : 571-577.

....(1983). Germination of *Populus ciliata* seed as influenced by moisture stress. *Indian For.*, **109** (6) : 357-358.

Singh, Virendra and R.V. Singh (1984 a). Seed dispersal, seed germination and seedling establishment in natural forests of Silver fir and Spruce I. Seed dispersal pattern. *Indian For.*, **110** (6) : 529-539

.... (1984 b). Seed dispersal, seed germination and seedling establishment in natural forests of Silver fir and Spruce II. Seed germination and seedling establishment. *Indian For.*, **110** (7) : 632-639.

Singh, Virendra, Ombir Singh and H.P. Sharma (1986). Germination of Silver fir (*Abies pindrow*) seed as affected by moisture stress. *Indian J. Forestry* **9** (4) : 293-295.

Zur, B. (1966). Osmotic control of the matric soil water potential I. Soil water system. *Soil Sci.* **102** (6) : 394-398.

RESEARCH NOTES
(I)

PROFILE DISTRIBUTION OF SULPHUR IN SELECTED SOIL SERIES OF TERAI AND TEESTA ALLUVIAL REGIONS OF WEST BENGAL

The present investigation pertains to the status and depthwise distribution of sulphur in selected soil series of Terai and Teesta alluvial regions of West Bengal and their inter-relationships with some important soil characteristies. Fourteen soil samples from three soil profiles represented by recognised soil series belonging to Terai and Teesta alluvial soil around Jalpaiguri district in West Bengal were collected from cultivated as well as forest areas. The pH and EC of the soils vary from 4.25 to 7.60 and 0.012 to 0.085 mmhos/cm, respectively. Organic carbon content and CEC vary from 0.10 to 1.42 per cent and 0.9 to 9.5 me/100 g, respectively. The soils are sand to clay loam in texture (clay 2.2 to 56.6%).

Total sulphur was determined by fusion of soil with sodium carbonate and sodium nitrate in the ratio of 50 : 1. Organic sulphur of soils was estimated according to Bardsley and Lancaster (1965) using sodium dihydrogen phosphate (4.6 g/l of 2N acetic acid). Extractants of Hoeft *et al.* (1973) for $CaCl_2$ and H_3PO_4 extractable available soil sulphur were tried and the concentration of S in all the extracts was recorded by Chesnin and Yien (1951) turbidimetric procedure.

The data shown in Table 1 reveal that the total sulphur content in the soil profiles ranges from 186 to 510 ppm with an average of 351 ppm. Total sulphur has positive and highly significant correlation with organic sulphur (r = 0.839). This is due to the fact that most of the sulphur present in acid soils is primarily organic in nature.

Organic sulphur content in the soil profiles ranges from 98 to 232 ppm with an average of 159.5 ppm and accounts for 35.4 to 55.6% (average 46.25%) of the total sulphur. Organic sulphur has positive significant correlations with organic carbon (r = 0.532), H_3PO_4 extractable S (r = 0.784), total sulphur (r = 0.839) and CEC (r=0.646). Sulphur supplying power of a soil depends upon its content and physico-chemical properties of soil influencing its release and dynamics. Since sulphur is an integral constituent of soil organic matter such relationship may be expected. The relation between CEC and organic sulphur can be accounted for due to more chemical affinity to the exchange sites of the soils and less release of the sulphur.

The amount of available sulphate sulphur extracted by H_3PO_4 varied widely but in majority of soil, it is constituted only a fraction of total sulphur. The concentra-

Table 1

Forms of sulphur in the Terai and Teesta alluvial soils

Depth (cm)	Forms of sulphur (ppm)			
	Total	Organic	H_3PO_4 extractable	$CaCl_2$ extractable
Sandy mixed hyperthermic typic Udifluvent-Barans Series				
0-13	352	184 (52.27)	61 (17.32)	12.0 (3.40)
13-32	300	126 (42.00)	36 (12.00)	11.6 (3.86)
32-65	342	172 (50.29)	45 (13.15)	21.6 (6.31)
65-82	402	160 (39 80)	39 (9.70)	15.5 (3.85)
82-105	372	184 (49.46)	32 (8.60)	12.2 (3.27)
105-133+	240	106 (44.16)	28 (11.66)	10.5 (4.37)
Clayey mixed hyperthermic typic Dystochrept–Haihaipathar Series				
0-15	510	232 (45.49)	46 (9.01)	19.5 (3.82)
15-30	324	152 (46.91)	30 (9.25)	7.8 (2.40)
30-61	444	209 (47.07)	44 (9.90)	10.2 (2.29)
61-90	492	174 (35.36)	39 (7.92)	11.8 (2.39)
90-120+	414	154 (37.19)	33 (7.79)	8.7 (2 10)
Loamy mixed hyperthermic typic Udifluvent–Lankapara Series				
0-3	252	124 (49.20)	30.5 (12.10)	36.0 (14.28)
3-7	186	98 (52.68)	17.5 (9.40)	28.8 (15.48)
7-39+	284	158 (55.63)	12.0 (4.22)	15 0 (5.28)

Figures in the parentheses indicate percentage of different forms of sulphur over total sulphur.

tion of H_3PO_4 extractable sulphur to total sulphur was high in the surface than in the sub-surface layer in all the soil profiles. This may be attributed due to better aeration condition near the surface through which organic sulphur is oxidised to sulphur by *thiobacilli*. This contention is supported by the highest correlation between organic sulphur H_3PO_4 extractable sulphur ($r = 1.784$) of the soils. H_3PO_4 extractable sulphur has no regular in its distribution throughout the individual profiles, as percentage of total S in soils. H_3PO_4 extractable sulphur has significant correlation with cation exchange capacity ($r = 0.597$).

The amount of $CaCl_2$ extractable sulphate sulphur varies from 7.8 to 36.0 ppm with an average of 15.08 ppm and accounts for 2.1 to 14.3% (average 5 22%) of the total sulphur. High rainfall in the Terai and Teesta alluvial regions of West Bengal and sandy loam texture of the soil have prevented accumulation of soluble sulphate sulphur in the soil.

The results of present study thus

revealed that among the different forms of sulphur as percentage of total sulphur in different soil profiles, the amount of sulphur extractable by different extractants was in order :

Organic (46.25%) > H_3PO_4 extractable (10.14%) > $CaCl_2$ extractable (5.22%).

In case of extraction with H_3PO_4, the phosphate ion replaces the absorbed sulphate. Thus H_3PO_4 removes both soluble and absorbed sulphate, whereas $CaCl_2$ extracts only the sulphate present in solution phase.

References

Bardsley, C.E. and J.D. Lancaster (1965). Sulphur P. 1102-1116. C.A. Black (ed.). *Methods of soil analysis.* Pt. 2, Agronomy 9, Amer Soc. Agron, Madison, Wis.

Chesnin, L. and C.H. Yien (1951). Turbidimetric determination of available sulphur. *Proc. Am Soc. Soil Sci.* **15**, 149-151.

Hoeft, R.G., L.M. Walsh and D.R Keeney (1973). Evaluation of various extractants for available soil sulphur. *Proc. Am. Soc. Soil Sci.* **37**, 401-404.

University College of Agriculture,
Calcutta University,
Calcutta (West Bengal)

A.K. Dolui
and
N. Das

(II)

CERCOSPORA BLIGHT DISEASE OF *MELIA AZADIRACHTA*

Melia azadirachta (Bakayan neem) is largely used as a social forest tree species because of its fast growth and dense shade. Its wood has pulp yielding quality. During the survey of disease in social forestry plantations at Jabalpur, heavy infection of *Cercospora subsessilis* Syd. was noticed. Agarwal and Sahni (1964), Sydow and Mcrae (1929) and Rao (1962) recorded this fungus on *M. azadirachta*. The infection was also severe in nursery. The pathogen infected both leaves and fruits ultimately caused severe losses to the plants and its fruits. The disease was very severe from December to March. The winter rains favoured the disease development. Under moist and cold conditions the disease spreaded from leaves to the tender shoots and juvenile fruits.

The infection started from leaves and ultimately high percentage of leaves exhibited the symptoms of disease. The lesions were grey to brown and scattered all over the lamina. In the later stages leaves, tender shoots and young fruits were involved in the infection processes but the severity of infection was more on leaves and fruits. The spot first appeared as a minute discolouration throughout the leaf blade which later became irregular or oval to rounded. All lesions were followed with a dark brown zone. The premature shedding of leaves and fruits took place due to infection. The affected areas were filled with tiny, pin head and black colour sporodochia of the fungus. The lesions on tender shoots were small and brown. The disease appeared as minute red, circular to irregular spots on fruits which later increased in size and covered large area. The center of spot became ash to grey and filled with numerous black pin head sporodochia. The natural colouration of the fruits lost due to infection and became shrivelled. The affected fruits were light in weight and the seeds were non-viable (Table 1). In few cases the infection in fruits resulted its abortive.

Table 1

The nature of healthy and infected fruits of M. azadirachta

Fruits	Total No. of fruits /100 g	Viability (%)	Germination (%)
Healthy	106	66	35
Diseased	234	10	3

The severity of infection affected the physiological processes of the plants which later influenced the growth. The seed production from the plants was also affected.

The two fungicides namely bavistin 0.1 per cent and dithane M-45 0.2 per cent were sprayed on ten plants of 3 year old each in order to control the infection. Both the fungicides were effective in controlling the infections. Dithane M-45 0.2 per cent is recommended for controlling the disease as it is cheaper than bavistin. The effective control of disease can be achieved by two sprays of the fungicides in the last week of November and December.

References

Agarwal, G.P. and V.P. Sahni (1964). Fungi causing plant diseases at Jabalpur (M.P.) *Mycopath et Mycol appl.* **22** (2) : 245-247.

Rao, P.N. (1962). Some *Cercospora* species from Hyderabad, India. *Indian Phytopath* **15** : 112-122.

Sydow, H. and W. Mcrae (1929) Hyphomycetes Indiae Orientali *Ann. Crpty Expt.* **2**: 262-271.

Institute of Deciduous Forests,
Jabalpur (Madhya Pradesh)

Jamaluddin,
V.S. Dadwal
and
Sima Sahare

REVIEW

Technology of Wasteland Development by Dr. Ram Prasad, IFS., Published by Associated Publishing Company, New Delhi. Pages—350 + 22 plates; Price Rs. 400-00.

Creation of wasteland and degradation of traditionally wooded lands are linked with social needs. Besides population control of man and domestic cattle, probable technology development is much more needed in production, distribution and regulation strategies. In fact restoring the wastelands to their initial productivity or even enhanced productivity need to be wedded well to the programme of population control, cattle improvement and intention agriculture as elements of wastelands development package programme. The author in this book has given very interesting observation that with increase of tribal population, per capita and gross forest areas increase. The author being a practical field forester and researcher, has been able to deal with the various issues involved in wasteland and development technologies, in a most professional and academic way. Problems in tackling the different facets have been highlighted and solutions thereof prescribed. The traditional practices, scientific approach and current concepts of bio-fertilizers, bio-technology etc. have been covered. Illustrative diagrams and spot-photographs have further enriched the quality of the book. The relevant and valuable data furnished in the book has made it a reference book and source of most wanted information commensurate with the cost.

At present there is a serious dearth of appropriate literature on wasteland development technology. Therefore, this book is most timely and rather relevant. The book contains three parts–'A', 'B' and 'C', 13 chapters with 22 photographs and 36 figures. All those concerned with wasteland development in any manner, will find the book very useful. It will be a basic reference book for Forest Departments, Department of Environment, Wasteland Development Board, Non Governmental Organisations, Industries, Universities etc. Of course the get-up and binding are very attractive and lasting. The size is also handy. The cost of Rs. 400/- for a book of this type is very reasonable.

G.P.M.

GAZETTE NOTIFICATIONS

ANDHRA PRADESH GAZETTE

Shri L. Krishna Bhupal Rao, I.F.S , State Silviculturist, Hyderabad is promoted and posted as Conservator of Forests, Logging Project Circle, Rajahmundry relieving Shri K. Subba Rao, I.F.S., Conservator of Forests, Social Forestry Circle, Vijayawada of the Additional Charge.

The services of Shri N. Rama Krishna Rao, I.F.S., who is on deputation with HUDA as Diractor, Urban Forestry, are withdrawn. On repatriation he is promoted and posted as Conservator of Forests, Anantapur Circle relieving Shri K. Rameswar, I.F.S., Conservator of Forests. Kurnool of the Additional charge.

Shri S.D. Mukherji, I F.S., Conservator of Forests, Adilabad, is transferred and posted as Conservator of Forests, Warangal.

Shri C. Subba Rao, I.F S., Conservator of Forests, Nizamabad is transferred and posted as Conservator of Forests, Adilabad vice Shri S.D. Mukherji, I.F.S.

Shri S. Subba Rao, I.F.S., Conservator of Forests, Social Forestry Circle, Vijayawada is transferred and posted as Conservator of Forests, Social Forestry Circle, Visakhapatnam vice Shri S.K. Das, I.F.S.

Shri S.K. Das, I.F.S., Conservator of Forests, Social Forestry Circle, Visakhapatnam is transferred and posted as Conservator of Forests, Social Forestry Circle, Vijayawada.

KARNATAKA GAZETTE

Shri B.R. Annaji Rao, I.F.S., Deputy Conservator of Forests, Social Forestry, Gulbarga is promoted to officiate in the Supertime–Scale of Indian Forest Service viz: Rs. 4500–150–5700, and appointed with the immediate effect and until further orders as Conservator of Forests, Research and Utilisation Circle, Bangalore vice Shri A.N. Yellappa Reddy, I.F.S., proceeding on leave.

On repatriation from the Government of India the services of Shri S. Jogaiah, I.F.S., Conservator of Forests are, placed at the disposal of Animal Husbandry, Fisheries & Forest Department with immediate effect and until further orders for appointment as Conservator of Forests in Karnataka State Forest Industries Corporation Ltd., Shimoga.

HIMACHAL PRADESH GAZETTE

The Governor, Himachal Pradesh, is pleased to order the following postings & transfers of IFS/HPPS–II Officers with immediate effect in the public interest :—

Sr. No.	Name of Officer	From	To
1.	Shri T.D. Sharma, IFS	D.F.O. Dalhausie	Dy. C.F. (M & E) in the office of Pr. C.C.F. Shimla.
2.	Shri R.K. Gupta, IFS	D.F.O. Chamba	D.F.O., Mandi vice Shri. J.C. Sharma.
3.	Shri J.C. Sharma, IFS	D.F.O. Mandi.	D.F.O. Dalhausie vice Shri T.D. Sharma
4.	Shri Vineet Kumar, IFS	ACF Jubbal	D.F.O., Churah vice Dr. Lalit Mohan.
5.	Shri Ramesh Chand, IFS	A.C.F. Kullu	D.F.O., Bharmour
6.	Shri Nagin Nanda, IFS	A.C.F. Dharamshala	Dy. C.F. (M & E) Social Forestry, Shimla
7.	Dr. Chandresh Sharma, IFS	A.C.F. Chamba	Dy. C.F. (M & E.) Social Forestry, Shimla
8.	Shri V.R.R. Singh, IFS	A.C.F. Chopal	Dy. C.F. (Extension) Social Forestry, Hamirpur.
9.	Shri M. Naryanappa, IFS	A.C.F. Dalhausie	D.F.O., Working Plan and Soil, Shimla
10.	Dr. Lalit Mohan	D.F.O. Churah	D.F.O. Chamba vice Shri R.K. Gupta.
11.	N.K. Bajpai, IFS	D.F.O. Bilaspur	D.F.O., Kunihar vice Shri D.R. Awasthy.
12.	Shri D.R. Awasthy, HPFS	D.F.O. Kunihar	D.F.O. Bilaspur vice Shri N.K. Bajpai.

———

FRI Publications

FOREST RESEARCH INSTITUTE & COLLEGES, DEHRA DUN

1. Silviculture of Indian Trees, Vol. V
   (Symbol No. PFRI-194)
   Price Rs. 193.50 or £ 22.57 $ 69.66 cents.

2. Indian Forest Record (New Series)
   Forest Influence Vol. 3, No. 1—1984
   (Symbol No. PFRI-213)
   Rs. 2.95 or £ 0.34 $ 1.07.

Available from :

The Controller of Publications,
Deptt. of Publication,
Civil Lines, Delhi-110 054

PROVIMI

SALTLICKS

FOR CATTLE, GOAT, SHEEP, HORSES,
DEERS, TIGERS, PUMAS, ZEBRAS &
Other Forest Animals.

CONTAINING : Iodine
Iron
Copper
Cobalt
Manganese
Magnesium
Zinc
Sodium

India's Top Selling Lick !

Provimi Saltlicks are of Vital Importance for the Health of your Livestocks

Manufactured By : **Provimi Products Private Ltd.**
Regd. Office : BANGALORE,
Factory & Administration,
3-F, Mill Road,
GOBICHETTIPALAM-638 476
Tamil Nadu.
Phone : 2593, 2493, 2707 & 2720.

for quality

PLEASE STEP TO—

Nocte Timber Company Limited

A Subsidiary of

Arunachal Pradesh Forest Corporation Ltd.

(A Govt. of Arunachal Pradesh Undertaking)

P.O. DEOMALI, TIRAP DIST. VIA-NAHARKATIA,

PIN-786629 (Arunachal Pradesh)

Phones Dl. 27, 29, 30.

Manufacturer of :—

Hot Pressed resin bonded, Commercial Plywood,

Decorative Plywoods, Shuttering Plywoods,

Nocte Special, Flush Doors

&

Block Boards.

SIMILIPAHAR

–a feast of floral and fauna beauty.

Similipahar a sal forest with scanty tribal populace in the district of Mayurbhanj, Orissa, has been implemented by Govt. of Orissa under recommendation from National Commission on Agriculture, for development of Forest and Forest Produce since 1979 under the banner Similipahar Forest Development Corporation Ltd. SFDC alongwith other activities have pledged them selves for a socio-economic growth of its inhabitants.

SFDC DEALS IN:

Timber, Firewood, Sal Seed, Railway Sleepers, Colliery Materials, Honey, Resin, Arrowroot, Gums, Tamarind and other forest products.

SFDC TAKES UP

Construction of Roads, Bridges, Culverts, Storage Godowns inside Similipahar Forest areas Plantation of Teak, Sal, Gamhar and other species and development of forest Generates employment among adivasis in forest workings about twenty lakhs a year.

SFDC BRANCHES AT.

Baripada, Badampahar, Karanjia Udaja Keonihar, Jajapur Road, Bhawanipatan, alongwith beautiful rest-houses in the midst of forest growths with connecting roads for tourists

SFDC SERVES PEOPLE:

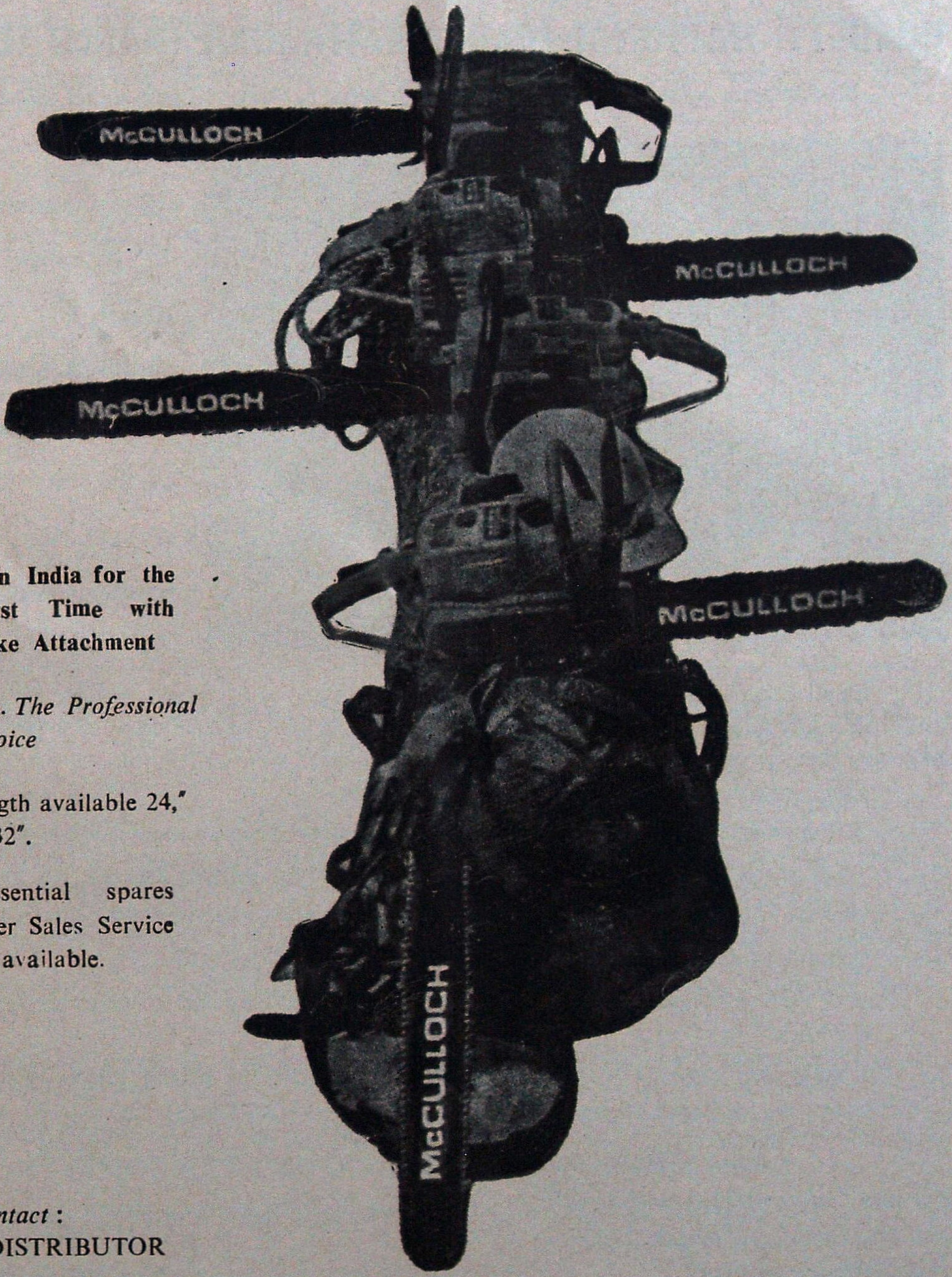
Firewood supply in 245 retail sale centres.

SFDC PROCESSING PROJECTS:

Import of Malayasian timber to save our forest, Plantation of Simarouba Glauca to meet oil seed deficit Plantation of rubber to save foreign exchange

S.F.D.C.
ORISSA

THE SIMILIPAHAR FOREST DEVELOPMENT CORPORATION LTD.,
(A GOVT. OF ORISSA UNDERTAKING)



Available in India for the very First Time with Chain Brake Attachment

McCulloch. The Professional Dealer Choice

1. Bar length available 24," 28" & 32".
2. All essential spares and after Sales Service readily available.

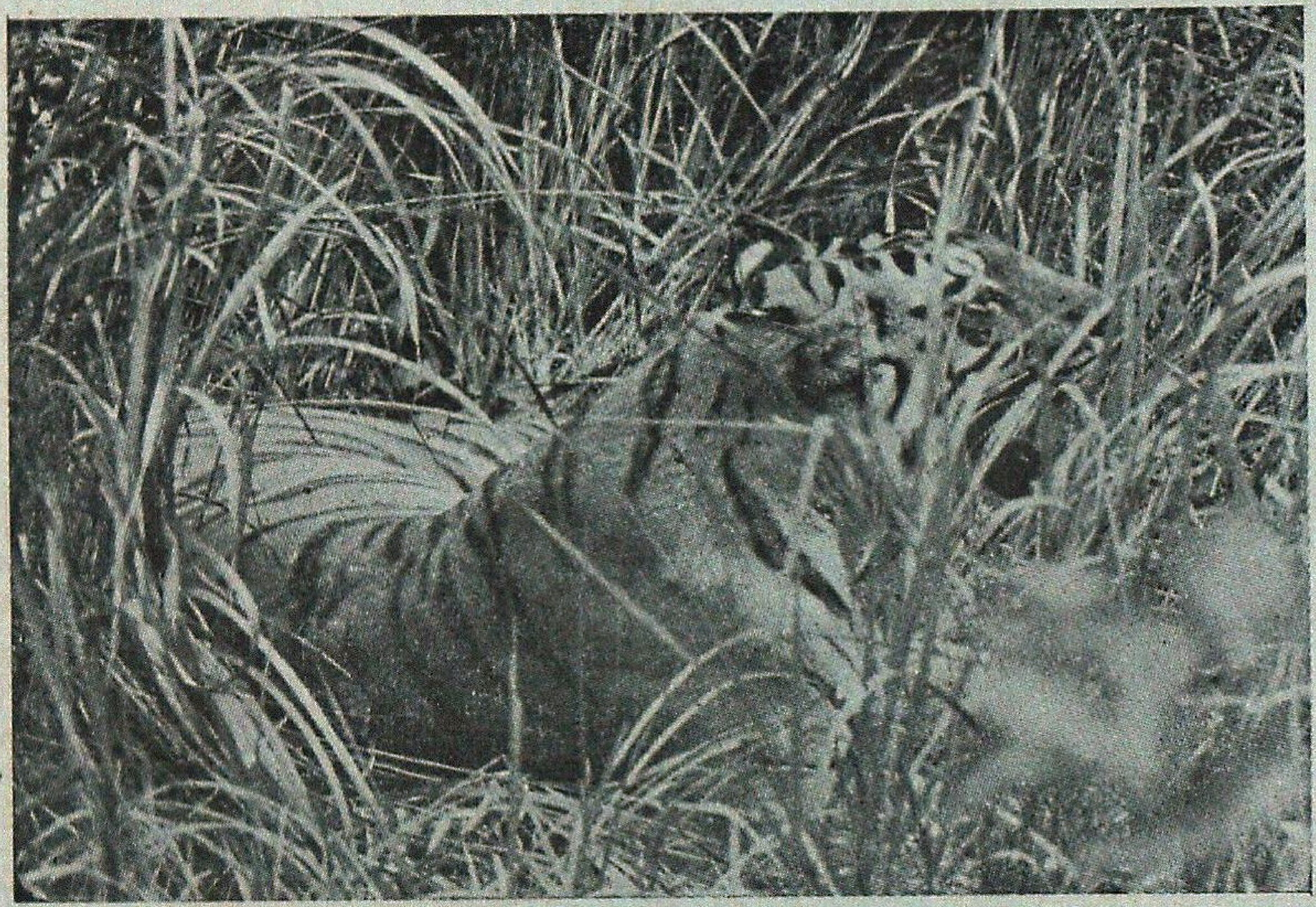
Please Contact :
"SOLE DISTRIBUTOR in India".

M/s. Indiana International

2001, Ugger Sen Street, Bazar Sita Ram, Delhi-110 006
Phone : Office : 734868 Resi. : 224-2737 Gram : "POWERCHAIN"
Res. Address : F-42, PREET VIHAR, DELHI-110092

CORBETT NATIONAL PARK, RAMNAGAR (NAINITAL) U.P.

Beckons you to its land of Roar, Trumpet and Song.



Have a date with nature in its superb magnificence and enjoy the thrill of obsərving wild animasl roaming freely in the vast wilderness. A paradise for bird watchers and anglers.

Elephants, chital, sambar, hog deer, barking deer, wild boar, magar gharial etc. and incredibly large varities of numerous beautiful birds. There is also very good chance of seeing tiger, panther or a bear in their natural habitat.

* Elephant rides arranged at reasonably low rates.
* Still photography permitted free; cine photography on nominal payment.
* High watch towers and tree top machans available for wildlife viewing.
* Picturesque scenery of the park provides an ideal holiday resort.
* Wildlife films screened daily free of charge.
* Well furnished Rest Houses and lodges available at various tourist centres inside the Park.
* Regular bus service available from Ramnagar to main tourist centre (Dhikala).

Nearest Rail Head—Ramnagar (N.E. Rly)
Nearest Bus stop—Ramnagar
} 50 kms from Dhikala

Eor other information contact or write to :

The Field Director, Project Tiger
Corbett National Park,
Ramnagar (Nainital), U.P.—244715
Phone : 32, 189 Office
76—Residence

OR

The Chief Wildlife Warden
17-Rana Pratap Marg,
Lucknow (U.P.)
Phone : 46140—Office
46817—Residence

Solar Powered Energy (Electric) Fence

Is protection a problem in your afforestation scheme? It is the damage to crops or wild-life protection that worries you?

Afforestation work can be a total failure due to bad protection, may be from wild animals or from cattle, and all your efforts wasted.

Erect Solar Powered Energy (Electric) Fence. It gives total protection even from elephants and destructive wild boars.

Energy (Electric) fence is effective, easy to install, economic and safe. Above all, it is environmentally clean, and ecologically compatible in forest areas. Totally dependent on Solar power, it is suitable even for remote areas, requiring minimum maintenance.

Please contact us for further details.

SURAKSHA
ENERGISERS

530-A 3RD CROSS, 3RD MAIN, R.T. NAGAR
BANGALORE-560 032, Karnataka (India) Phone: (0812)–333666/369777

Punjab State Forest Development Corporation Ltd.

KOTHI NO. 165, SECTOR 36-A, CHANDIGARH

In view of large scale plantations of eucalyptus trees raised on private lands in the States, the Corporation has made efforts to find out multiple uses of eucalyptus wood. Apart from uses of eucalyptus for battens, crates, firewood, pulpwood etc., the Corporation has developed uses of eucalyptus for packing cases, building construction, truck body building, furniture making, tool handles, wooden poles, plywood, activated charcoal etc. The Corporation has received orders from the Punjab Housing Development Board for supply of eucalyptus timber to be used in the fabrication of door and window frames. The Corporation has taken in hand some work in regard to supply of battens to the Panchayati Raj Punjab, for use in their buildings.

The Corporation has recently embarked upon a prestigious programme for fabrication of lamps, items of household and office furniture as well as misc. articles of wood of daily use. The lamps are available in exquisite designs, shapes, sizes and are suitable for residences, offices, hotels, bars, lounges etc. The furniture made from eucalyptus wood is of good quality, durable, attractive, reasonably priced and of good finish.

For your requirements and further details, please contact the Managing Director.

Y.P. CHOWDHRY
Managing Director

Tel. 40586

With best compliments

from

WOOD PRESERVERS PVT. LTD.,

F–27, MIDC INDUSTRIAL ESTATE,
NAGPUR–440 016 (Maharashtra).

GRAM : WOODTREAT

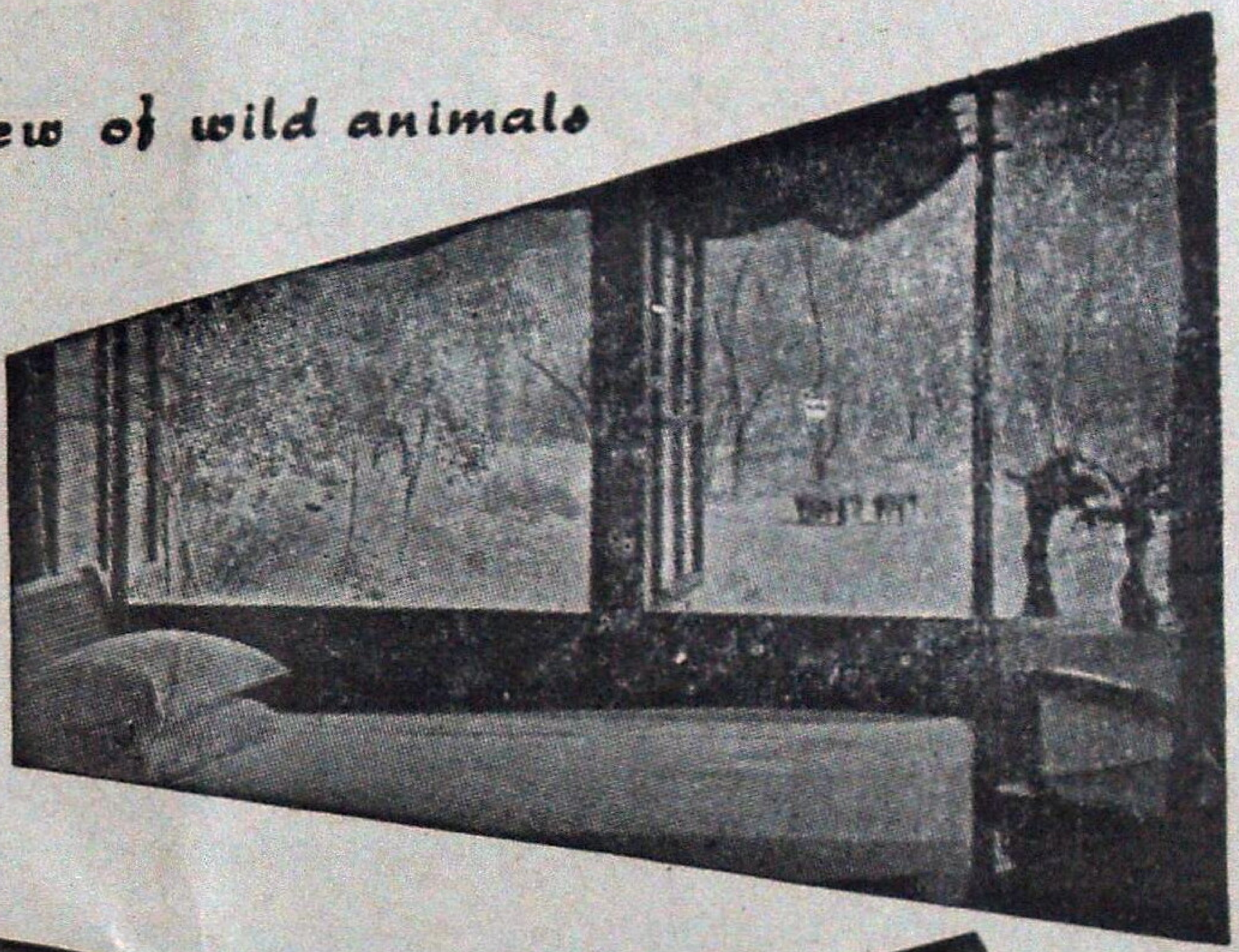
Phone : Fact. 7451, 7210
Resi. 23131

Manufacturers for :

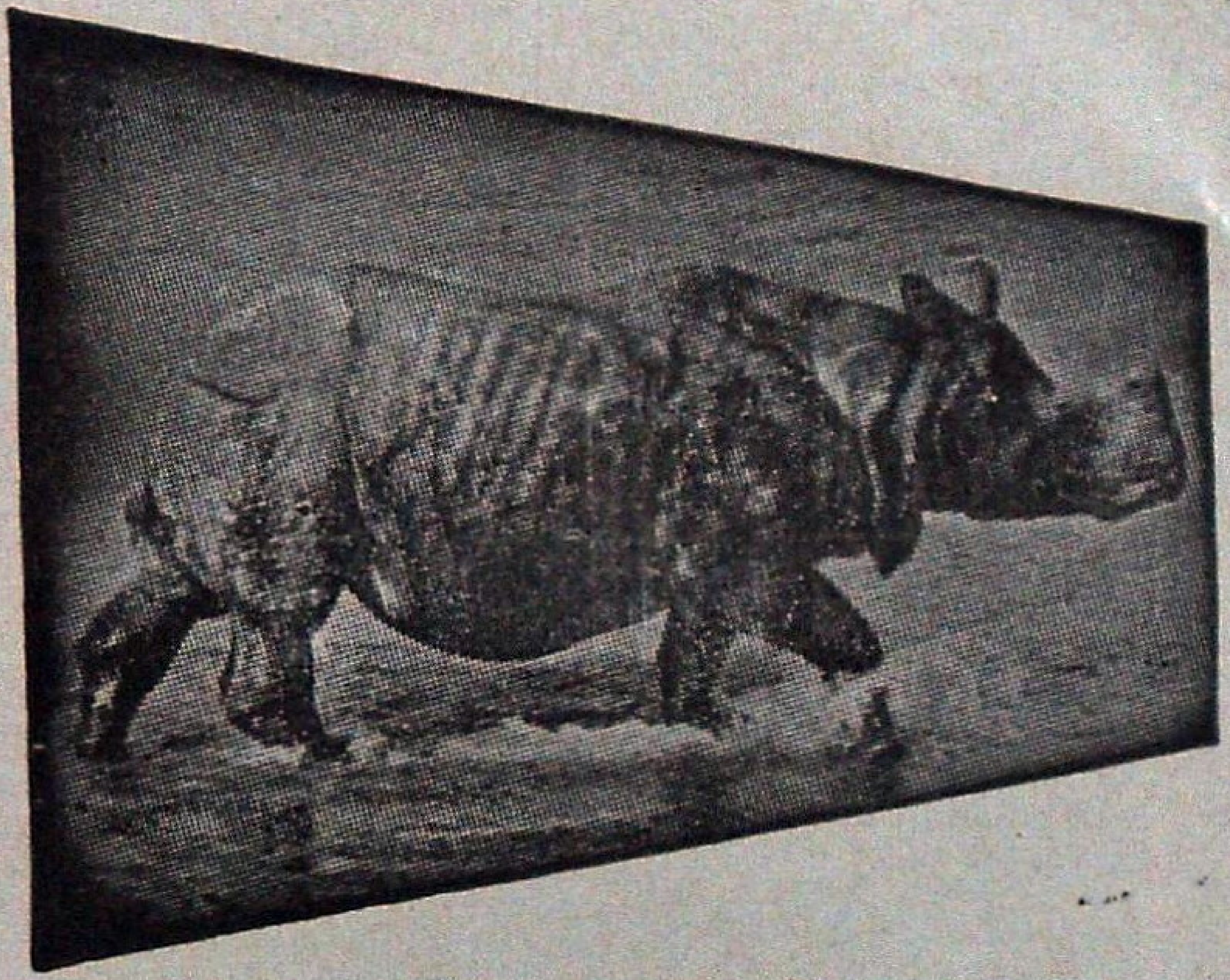
"Railway Sleepers, Pre-cut structures, Marine Constructions materials, Fabricated and engineered wood products, Wood Preservative Copper Chrome Arsenic Composition, Kiln drying Pressure Preservation treatment, Ammunition Boxes, Wooden Pallets, Packing cases and Crates."

"Enquiries particularly solicited for unusual and difficult items."

Have a bedroom view of wild animals



VISIT



JALDAPARA
WILD LIFE
Sanctuary

* Home of One-horned Rhinoceros.
* Gaur, Elephants, Tigers
* Varieties of Deer and other Animals.
* Furnished Tourist Lodges with full Catering arrangement.
* Appro ıchable by Road, Train and Air.
* Jeep av a lable.

Please contact:

DIVISIONAL FOREST OFFICER
WILD LIFE DIVISION–II
JALPAIGURI
(WEST BENGAL)

OR

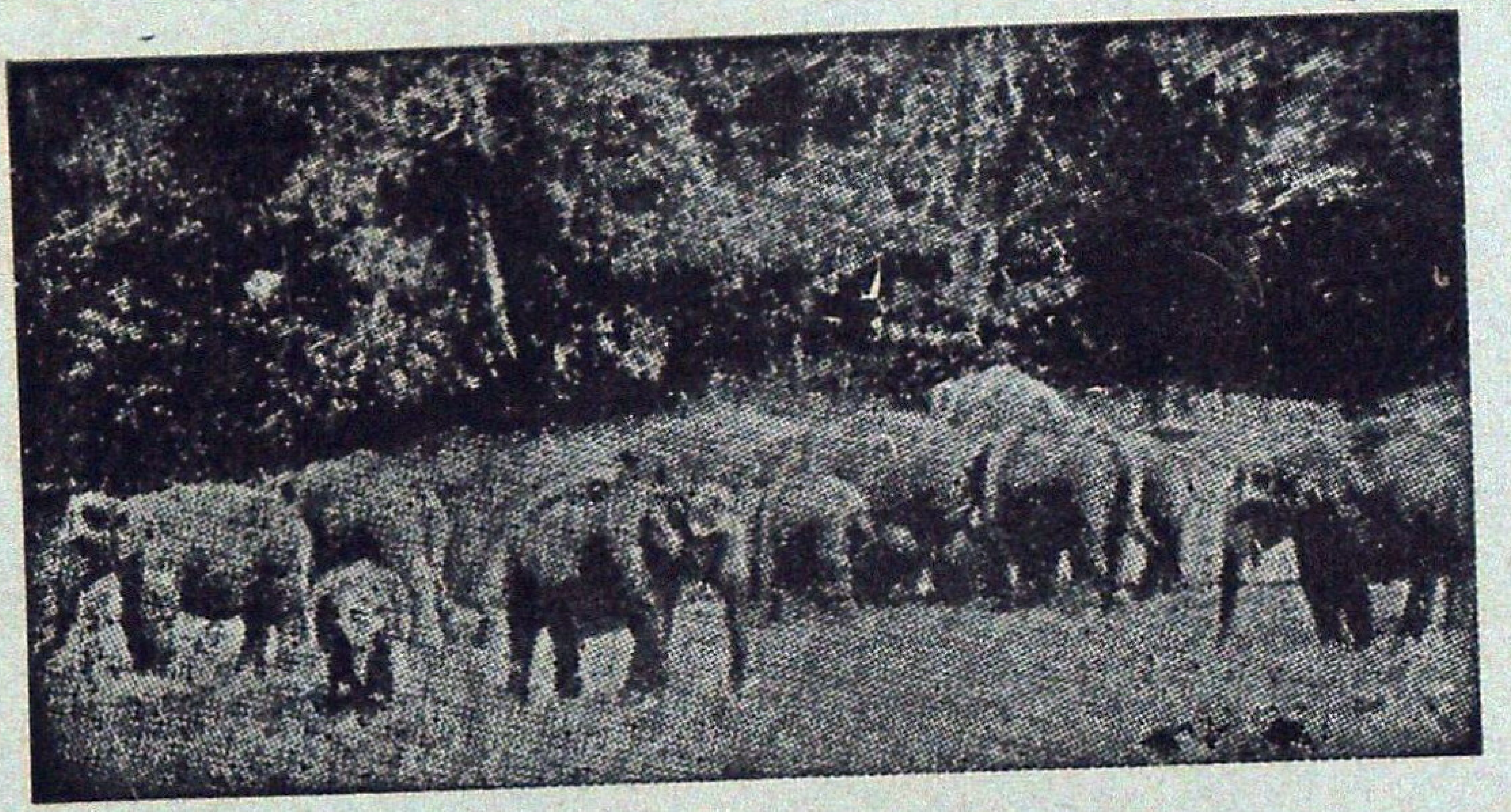
FOREST UTILISATION OFFICER
8, Lyons Range, CALCUTTA
[Phone: 22-2774]
WEST BENGAL

VISIT **PERIYAR TIGER RESERVE**

THEKKADY (KERALA STATE)
(OPEN ALL YEAR)

OBSERVE

Elephants, Gaur, Sambhar Leopard, Wild Dogs, Black Langur, The Giant Malabar Squirrel, Birds and other indigenous Fauna.



—

Hotels :
Western Style—Aranya Nivas
Indian Style—Periyar House.
(Accommodation in Hotels reserved by Managers)
†Frunished Forest Rest Houses at Thannikudy, Mullakudy and Manakavala.
†Motor Boats available for most enjoyable cruise in the lake.
†Elephant rides.
†Approachable by Air or Rail up to Cochin or Madurai.
Distance to Thekkady by roads is 190 km from Cochin, 145 km from Madurai and 110 km from Kottayam.

For further particulars contact :—WILD LIFE PRESERVATION OFFICER
Thekkady P.O., (Kerala) Telephone : KUMILY 27

FOR ROPING AND PLANTING TREES

POLYTHENE BAGS

GUSSETTED–PERFORATED OR PLAIN

Contact for Immediate Supply

KANPUR PLASTIC COMPANY

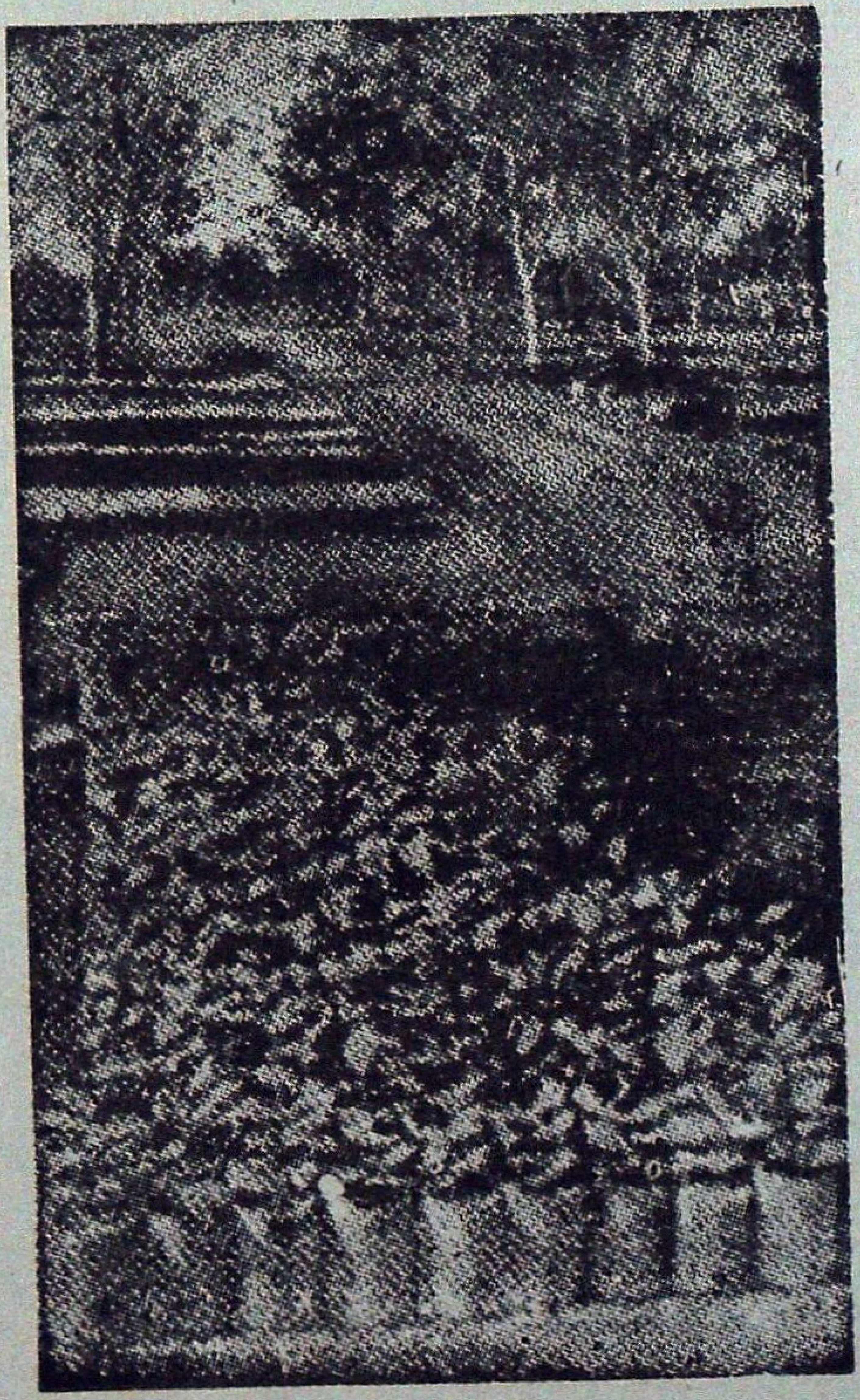
111/423, Ashok Nagar, KANPUR-208 012

Phones { Office : 243721 & 244992
Resi. : 245954
Fac. : 244993

Gram—KANPLASTIC
Estd.—1956

———

ALL SIZES OF POLYTHENE BAGS IN REQUIRED GAUGE & SPECIFICATIONS AVAILABLE



ONE UNIT PLYWOOD

EQUALS

Three Units Sawn Timber

Use Plywood and Conserve Timber

★

THE INDIAN PLYWOOD MFG. CO. LTD.

9, WALLACE STREET, FORT,

BOMBAY-400 001 (Maharashtra)

Factories at : Dandeli, Dharwad, Talaguppa, Subramanya and Hungarcutta.

VISIT : **Palamau National Park**

Famous for the abundance and variety of wildlife—Tiger, Panther, Elephant, Gaur, Samber, Spotted deer, Barking deer and numerous species of beautiful birds,

*Picturesque Scenery.

*A place of historical importance the old and the new Palamau Fort of

*Chero Kings.

*Ideal holiday resort.

Well furnished tourist Lodges and Forest Rest Houses with catering

*arrangement.

Beautiful Watch Towers, tree-top

*and Hide-outs-all connected by roads.

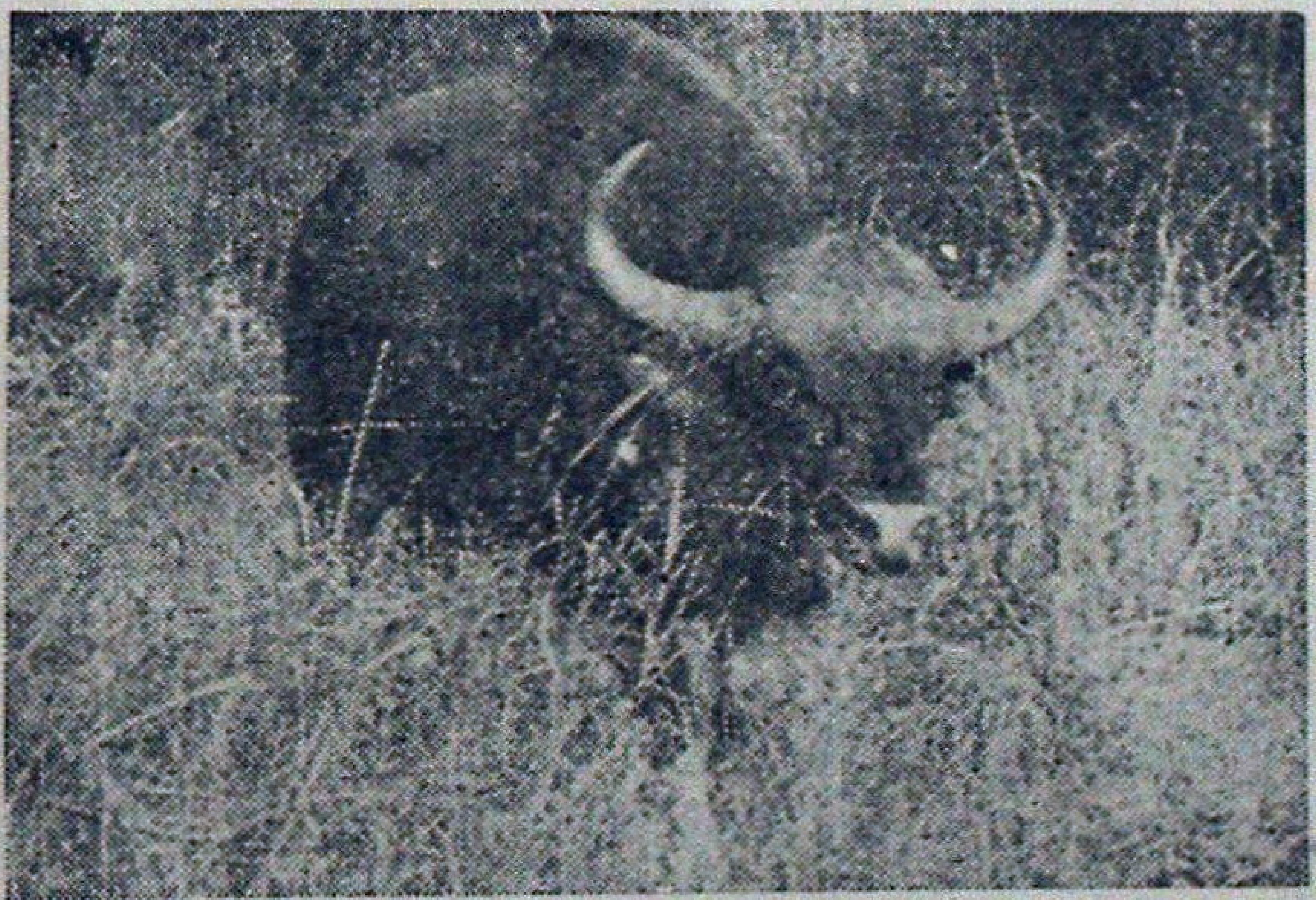
*Remains open throughout the year.

Snaps and movie permitted free of

*charge.

Approachable by road and rail–26 kms from Daltonganj 12 kms from Chhipadohar Rly. Station. Well connected by roads with comfortable Bus service.

Nearest Airport—Ranchi 175 kms.



For further particulars write to :

THE FIELD DIRECTOR, PROJECT TIGER,

Palamau Tiger Reserve,

P.O. Daltonganj, Bihar, (India)

We have pleasure to introduce ourselves as :

* Producers of Round Timber for Veneering and Saw Mill.
* Manufacturers of Tea chests and Commercial Plywood.
* Suppliers of Sawn Timber and Furniture.
* Cultivators of Coffee, Cardomom, Rubber, Cocoa, Tea and other cash crops.
* Manufacturers of Match and Polythene Bags.

Arunachal Pradesh Forest Corporation Limited

(A Govt. of Arunachal Pradesh Undertaking)

DEOMALI

Regd. Office :
ITANAGAR—791 111
Distt. Sabansiri
(Arunachal Pradesh)

Head Office :—
P.O. DEOMALI—786 629
Distt. Tirap
(Arunachal Pradesh

FOREST RESEARCH DIVISION
RANCHI-834002 (BIHAR)

Under tribal sub-plan we produce and sell following goods every year :

* Sealing Wax
* French polish
* Seed lac
* Sisal fibre suitable for rope making.

Interested buyers should contact :

FOREST RESEARCH OFFICER,
BIHAR
FOREST RESEARCH DIVISION
P.O. HINOO,
RANCHI-834002 (BIHAR)

Associate yourself with the

INDIAN FORESTER

as

Advertiser—Subscriber

or

Contributor

Himachal Pradesh State Forest Corporation Ltd.

(A Govt. of Himachal Pradesh Undertaking)

SHIMLA

HPFSC marches ahead towards a better tomorrow under the dynamic guidance and leadership of Hon'ble Chief Minister Shri Vir Bhadra Singh.

Himachal Pradesh State Forest Corporation has taken long strides under the benevolent guidance of our Chairman Prof. Chander Kumar, Hon'ble Minister of State for Forests.

* With complete nationalisation of forest working viz; timber operations, resin tapping etc. both in Govt. and private forests, there is complete elimination of contractor' agency. Modernisation of timber operations has reduced conversion wastage considerably and the incidence of organized illicit felling in forests is completely under control.

* To ensure gradual reduction in use of valuable coniferous timber for packing cases, effective steps have been taken for distribution of Card Board Cartons and purchase of Wooden Packing Cases from adjoining States of Punjab and Haryana.

* Stocks of timber extracted by Corporation are being supplied towards developmental works by catering to the requirements of Indian Railways, Director General of Supplies and Disposals, Defence Organisation and other Govt. Indenters. Sale of timber stocks is being organized through well established sale depots conveniently located.

* The annual turn-over has registered a significant increase from its inception from 1974-75 being Rs. 2.43 crores to Rs. 44.83 crores in 1986-87.

In order to maximize operational efficiency, following steps have now been initiated :

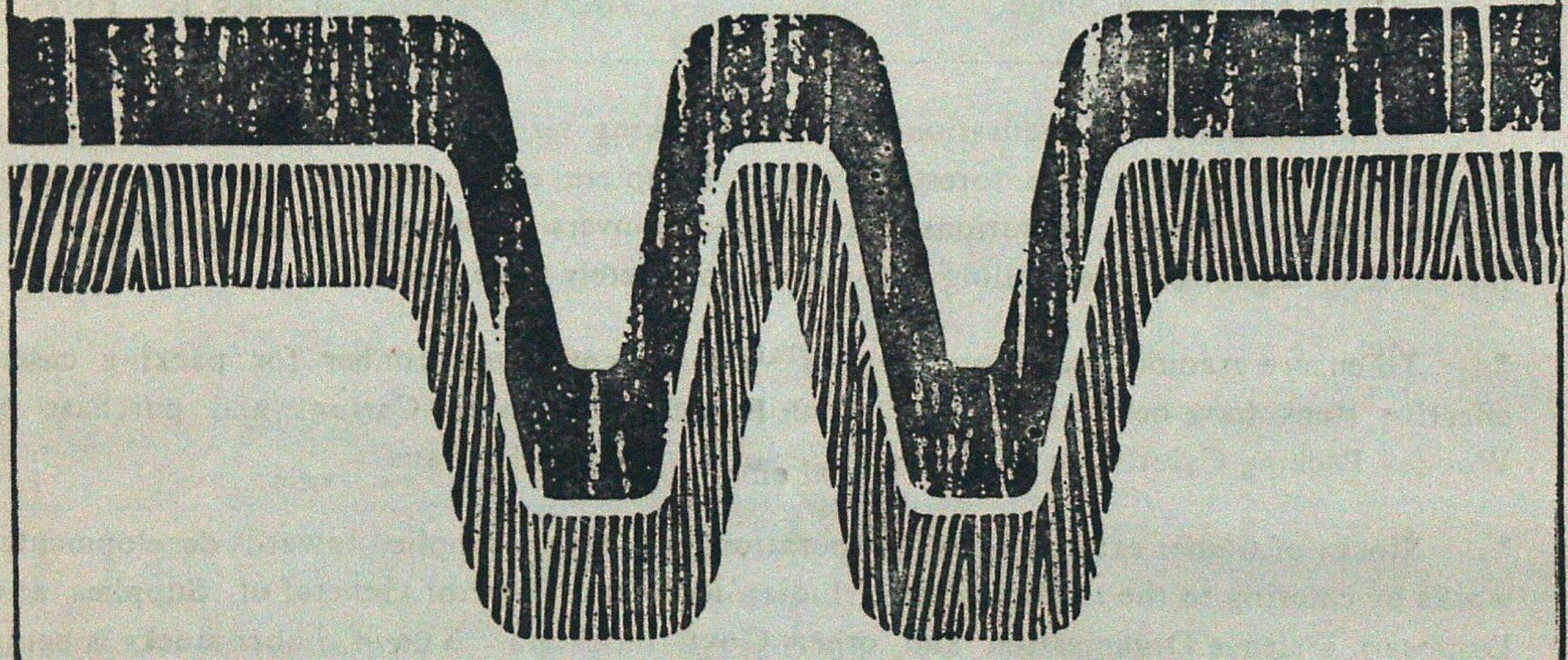
a) Replacement of old fleet of trucks for minimising transportatton time of timber to depots;

b) Analysis of financial data through computer net-work to ensure prompt and efficient working.

c) Providing incentives to officers and staff through prompt action on service matters like confirmations, job rotation vis-to-vis career planning including specialized training.

(V.P. Mohan)
Managing Director.

WUDGARD



THE NEW NAME IN WOOD PRESERVATIVES

- **WUDGARD** For All Applications — In Homes, Factories, Transmission Poles, Industrial Products, Packages.
- **WUDGARD** Can be Applied By Dipping, Brushing, Spraying or Pressure/Vacuum Impregnation As Per IS : 401 Specification and Some, Sophisticated Grades For Special Care.
- **WUDGARD** Wood Preservatives, manufactured in India by

INDROL

INDROL Lubricants & Specialities Ltd.

Head Office: 91, Walkeshwar Road, Bombay-400 006
Branches at Bombay, Calcutta, Delhi and Madras
Depots and Consignment Stockists — All Over India

Sorvicson

Madhya Pradesh Forges Ahead : Forestry for the People

Madhya Pradesh is the 'Guardian State' of India. Upper catchment areas of important rivers lay here. They are to be kept tree-clad.

Forests conserve Soil and Water besides ameliorating environment. Plantation targets from all sources stand at about two lakh hectares including Wasteland Development Progamme. People's participation in afforestation programme is encouraged through Social Forestry which covers the whole State. M.P. Forests are a great source of non-tax revenue They generate eight-crore man-days of annual employment. Forestry-activities provide jobs to weaker sections of society in lean season.

Fuel-Fodder-Timber-Bamboo-Tendu Leaves-Sal-seed, Gums etc - all are derived from our Forests.

Forests harbour Wild Life too :

M.P. has 11 National Parks and 31 Game-Sanctuaries covering more than 11 per cent of the forest area.

Save Forests : Save Wild Life.

Issued by :

Director General of Forests,

Madhya Pradesh.

JALSHAKTI TM

ADVANTAGES

* Jalshakti increases water holding capacity of any Soil mixture
* Jalshakti reduces watering needs
* Jalshakti helps prevent Transplant Shock
* Jalshakti helps extend period between watering.
* Jalshakti encourages germination, establish Transplants and seedlings.
* Jalshakti provides lasting supply of water.
* Jalshaki promotes vigorous growth and nutrient uptake.

USED IN

* Seed Coating
* Soil Mix
* Nursery Beds
* Mainfield Planting in pits and Trenches.
* Bare Root Transplanting.

For further details, contact :

INDIAN ORGANIC CHEMICALS LIMITED

Sales Office :
Mehta Mahal, 15, Mathew Road,
BOMBAY—400 004
Phone : 8111428, Telex : 011-75147

Factory :
KHOPOLI—410 203
Dist. RAIGAD, Maharashtra
Phone : 328/528
Gram : TEZAB

The Moments of Life Time Experience await you

IN SASAN–GIR

you have a date with the

King & Queen

of Animal World

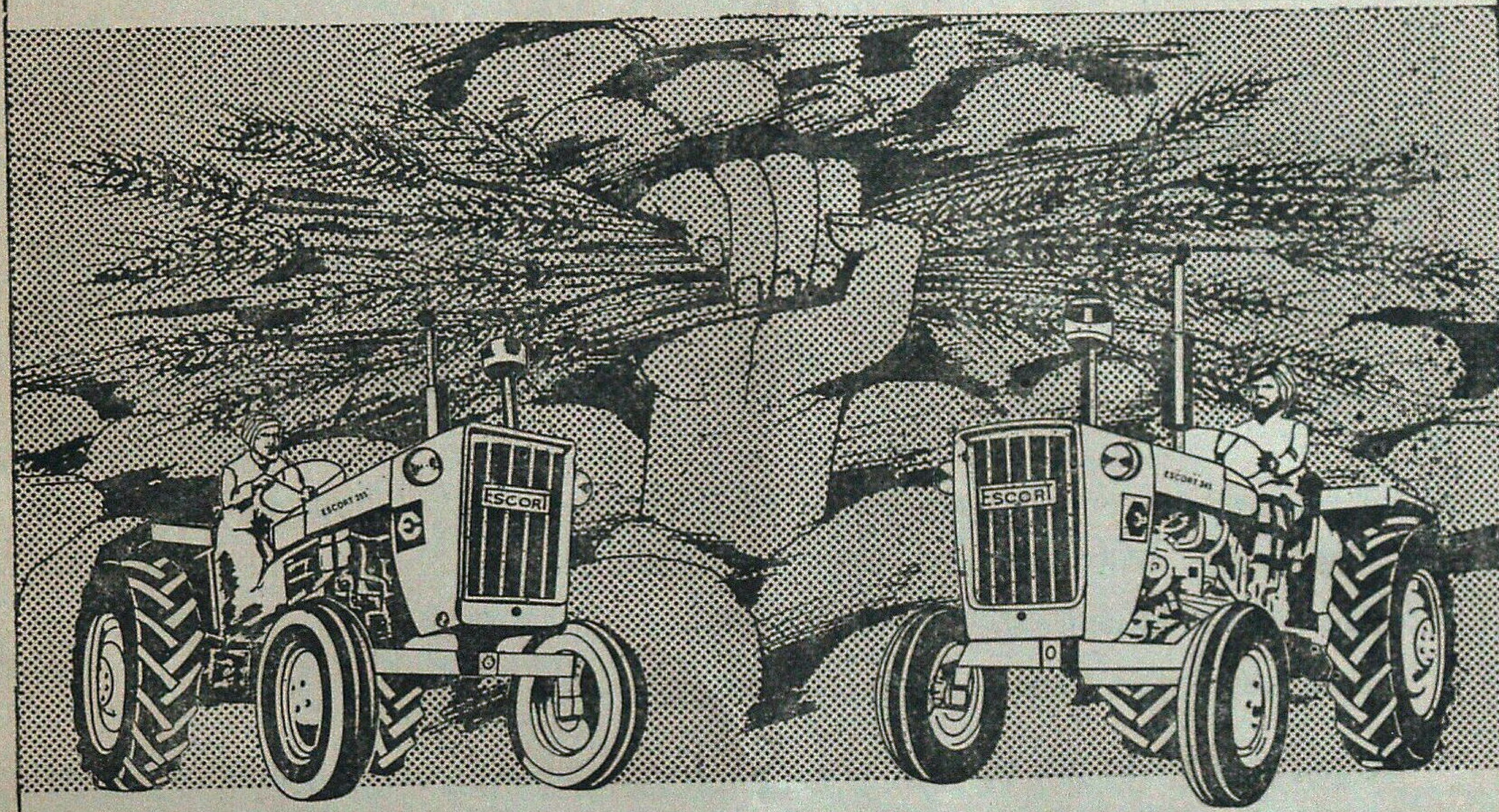
The most Majestic Royal Animal species—

The Rare Asiatic Lion

For more details contact :
Deputy Conservator of Forest,
Wild Life Division,
P.O. Sasan-gir - 362 135
Distt. Junagadh, Gujrat.

MORE POWER AT YOUR COMMAND

ESCORTS



MATCHLESS
ESCORT-355
47 HP, 3 Cylinder, Water-cooled,
High Torque Engine : 18 kgm at 1400-1600 rpm.

TRACTOR KESARI
ESCORT-345
35 HP, 2 Cylinder, Water-cooled,
High Torque Engine : 12 kgm at 1400-1600 rpm.

Both, ideal tractors that you have been in search of.
These tractors have in-built features tailor-made to suit your requirements both in the field and on the road.

We at Escorts, set out years ago on a noble venture. It began with the determination of paying back the farmer, the real inventor of the revolutionary wheel, with farm equipment that fulfilled all the farmers' needs.

Today the farmer can possess the tractor he longed for, and put it to work both for his and the nation's prosperity.

This has been made possible through the persistent and specialised endeavour of the best equipped and manned Escorts Corporate Research and Development Centre which has enabled the farmer to get a tractor with the best features:

- More power
- More speed
- More effective brakes for paddy cultivation and tough terrains
- Unmatched dependability
- More fuel economy
- More haulage capacity
- Reasonable price

The highlights. Matchless ESCORT 355. Tractor Kesari ESCORT 345.

- Fuel efficient in every operation both for field and haulage.
- Water-proof self starter and fully enclosed brakes make it ideal for paddy cultivation.
- Fully automatic hydraulics (ADDC).
- 8 ply nylon tyres, safe for forward and reverse speeds.
- Ideally suited for compressor mounting.
- Recirculating ball type steering.
- E-355 with Disc brakes (optional)
- The unmatched ESCORT 1500 hour warranty, covering 12 months.
- Six month warranty on spare parts.
- ESCORT 24 hour service to reach out to you wherever you are. A network of 600 dealers offer genuine spare parts at reasonable prices.

ESCORT 1500 HOUR WARRANTY

WE UNDERSTAND YOUR NEEDS BETTER

24 HOUR SERVICE ESCORT

LINTAS/DELHI/ESC FED 39 2720

FOREST SERVES ALL

- We have sale centres at Salt Lake Calcutta, Durgapur, Bankura, Purulia and Midnapore for superior quality Sawn timber and Plywood for making doors and windows. Black Board and Readymade furniture are also sold at reasonable price.
- If you intend to purchase readymade door, window, flushdoor and furniture please contact the Salt Lake Sale Centre at Calcutta, Govt Saw Mills at Siliguri or the Saw Mills at Madarihat. We will meet your requirement or arrange supply of materials of your choice.
- Good news to the pan chewers also, we are producing good quality of Khair (Katha) and selling this in polythene packets of 10 Gms., 25 Gms., and 100 Gms. from our sale centres. If any chewer has used this once he will never forget to purchase again and again.
- Pure Honey, Citronella Oil, Orchid and various flowers are also available from the sale centres.

West Bengal Forest Development Corporation Limited

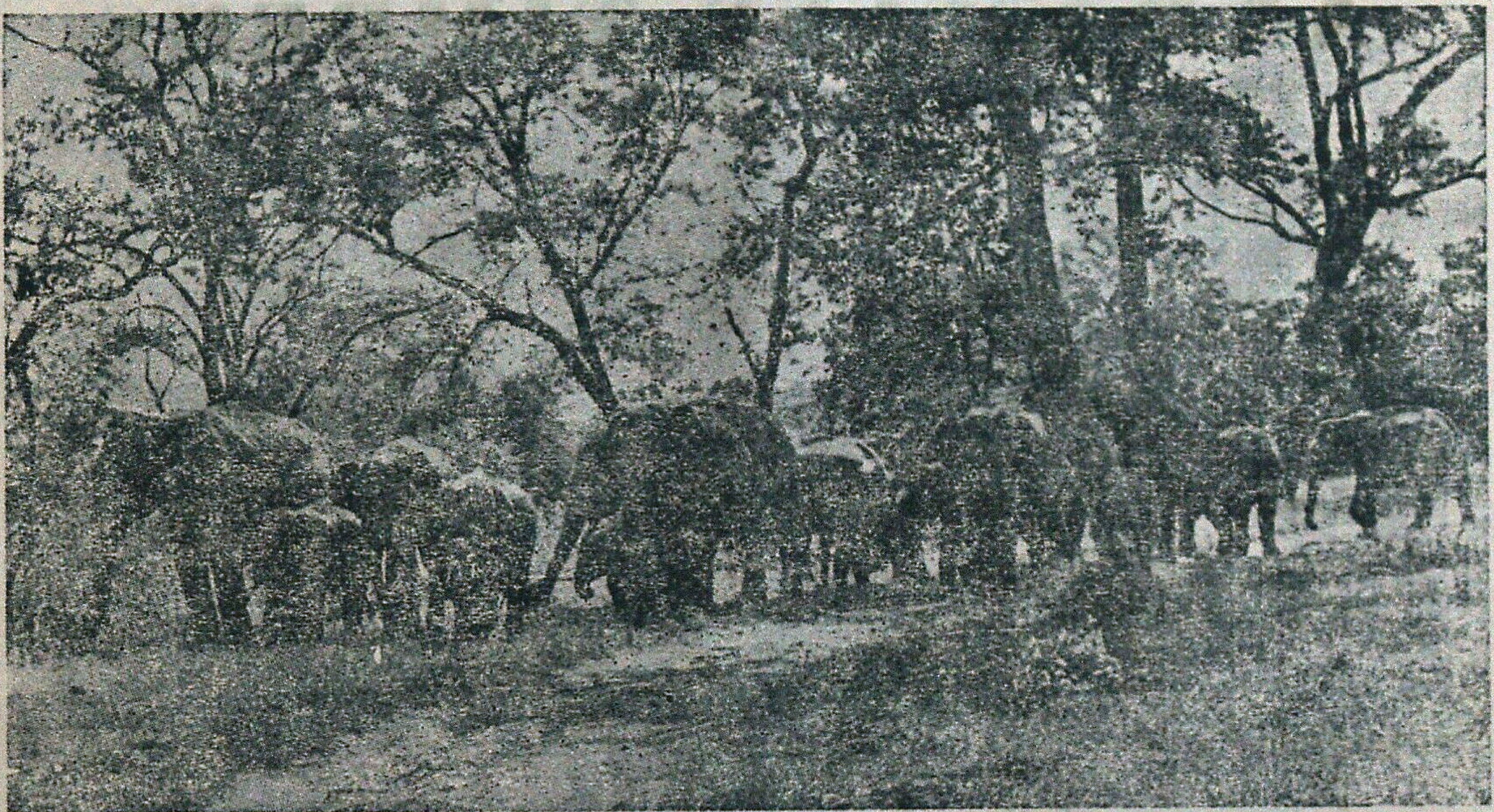
(A Government of West Bengal Undertaking)

6A, Raja Subodh Mullick Square (7th floor)

Calcutta-13

BANDIPUR TIGER RESERVE

KARNATAKA



Lovers of nature and Wildlife the world over find it well worth their while to linger on in Bandipur. More famous as a Tiger Reserve, Bandipur enjoys reputation as a wildlife sanctuary that stretches as far back as 1931. The Mysore Maharajas; benign rulers and farsighted visionaries understood the compelling necessity of protecting the fauna, avifauna and flora from the thoughtless foreys of marauders. Today 874 sq kms. of the Bandipur National Park makes up the Tiger Reserve which is one of India's finest parks.

But Tigers, native to the country and the most magnificent of the great cats are saved from threatened extinction. An abundant variety of fauna: the panther, wilddog, Sloth bear, Sambar, Chital, barking deer, fourhorned antelope, common langur; avifauna like peacock, grey jungle fowl, crested hawk, eagle and reptiles such as crocodiles, Python, Vipers, etc., roam this park freely.

Hundreds of spotted deer greet the visitors right at Bandipur campus, at night times as they step out of comfortable cottages.

A herd of elephant majestically moving single file through a patch in the jungle can be viewed on an elephant ride. If one is lucky he can watch in absolute silence, of course—a herd of Indian 'bison' or gaur, locking horns a few meters away.

Nature at its bountiful best - Bandipur bestows the soothing solace of jungle retreat off the beaten track and far from the madding crowd.

For further particulars, please contact

The Field Director
'Project Tiger'
Government House Complex
MYSORE 570 010
(Karnataka—State) India
Telephone No 20901

WHATEVER YOUR NEED

There is a Species of

ANDAMANS TIMBERS

TO SUIT YOUR REQUIREMENTS

CONTACT :

1. The Chief Conservator of Forests,
Andamans & Nicobar Islands,
Port Blair

2. The Deputy Conservator of Forest
(Depot Division)
Andamans Govt. Timber Depot,
3-A, 2nd Floor, Auckland Place,
Calcutta-17.

3 The Assistant Conservator of Forests,
(Depot Division)
Andamans Govt. Timber Depot
Marshalling Yard, Port Trust, MADRAS.

SALE SALE SALE

A few copies of the following **SPECIAL ISSUES** of the *Indian Forester* are available for sale :

November, 1969	—	International Union for Conservation of Nature and Natural Resources.
January, 1975	—	Indian Forester Centenary Issue.
February, 1979	—	International Symposium on Tiger
September, 1984	—	Biomass—II
November, 1985	—	International Year of the Forests
December, 1985	—	Eucalyptus IV
July, 1986	—	Brandis Memorial/Environmental Conservation
Octobe, 1986	—	Wild Life
September, 1988	—	Bamboo Special—I
October, 1988	—	Bamboo Special—II

The cost of each issue is Rs. 40.00. Forwarding charges will be extra. In case you intend to purchase any of these issues before the stock is exhausted, kindly send your order together with the relevant payment to :

The Business Manager,
INDIAN FORESTER,
P.O. New Forest,
Dehra Dun-248006 (India)

TWELVE YEARS OF ACHIEVEMENT TWELVE YEARS OF PROGRESS

Madhya Pradesh Rajya Van Vikas Nigam Limited

Rededicates itself for rehabilitation of Green Glory

71372 ha	of Teak Plantation
27331 ha	of Bamboo Plantation
1585 ha	of Tropical pine plantation
3303 ha	of Industrial plantation
41749 ha	of afforestation under Drought Prone Area Programme
334 ha	R.K.M. length of Avenue plantation
3708 ha	of Mixed plantation
10845 ha	of Pasture Development

Modest contribution of setting up of Forest based industries

— Bastar Wood Products Jagdalpur a joint venture

— Narmada Wood Products Itarsi our sole Enterprise

— Polythene bags Manufacturing in Itarsi

— Supply of food to labourers under World Food Programme.

— Supply of Sal Sleepers to Indian Railways.

— Amelioration of Rural people through Training and Employment in Wood Craft Centres.

— Annual Labour Payment Rs. 10 Cr.

— Annual employment of 65 lakhs Mandays.

— Labour Welfare Schemes of Rs. 36.50 lakhs.

With Best Wishes.

(R.S. Mishra)
Managing Director.

GROW POPLARS FOR PROSPERITY

AND YOU WILL HELP AMELIORATE THE ENVIRONMENT TOO

The **WIMCO-NABARD** Farm Forestry Project in U.P., Punjab and Haryana offers you the benefits of combining forestry with farming to increase your returns.

WIMCO provides:

* High quality plants of selected Poplar clones.
* Extension services and technical guidance till harvest.
* Assistance in securing bank loans and insurance cover for Poplar trees.
* Buy back guarantee at assured minimum price at 8 years rotation.

Over 5000 farmers have planted more than 48 lakh trees from 1984 to 1988.

Districts covered

U.P. : Moradabad, Bareilly, Meerut, Badaun, Shahjahanpur, Saharanpur, Ghaziabad, Pilibhit, Lakhimpur Kheri, Bijnor, Bulandshahr, Rampur, Nainital, Aligarh, Etah, Bahraich, Hardoi, Muzaffarnagar.

Punjab : All districts.

Haryana : Karnal, Ambala, Kurukshetra, Sonepat, Hissar, Jind, Sirsa, Rohtak & Faridabad.

Just write to us, or visit our office nearest to you, for more information.

WIMCO

WIMCO LIMITED

No. 5, Block E, Local Shopping Centre, Masjid Moth, New Delhi-110 048

Moradabad : 9, Awas Vikas, Civil Lines. Ph : 27992.

Bareilly : B 9/35, Rampur Garden. Ph: 72081.

Meerut : F-194, Shastri Nagar. Ph. 73202

Chandigarh : 224, Sector 18-A. Ph. 20558.

Karnal : 843, Sector 13, Urban Dev. Estate.

RULES OF CONTRIBUTIONS

1. Contribution should be sent to the Honorary Editor, *Indian Forester*, Forest Research Institute, P.O. New Forest, Dehra Dun, or to any Member of the Board of Management or Central Editorial Board and should be written legibly in ink *preferably* typed.

2. The Central Editorial Board does not hold itself responsible for the opinions expressed by the authors.

3. The Central Editorial Board reserves the right of accepting or rejecting any contribution and of making suitable alterations and amendments, without assigning any reason.

4. Contributors are invited to sign their contributions in preference to affixing to them a *nom de plume*, since professional opinion naturally carry more weight when their author is known. All communications must be authenticated by the name and address of the writer being communicated to the Honorary Editor, whether intended for publication or not.

5. Contributors will be supplied with 30 extra copies of their contributors, together with any illustrations accompanying them, free of charge. Additional copies will be charged for at the rate of twenty paise per page per reprint. *Contributors desiring extra copies should state the number of reprints required when sending articles, otherwise they will not be available.*

6. No payments will be made to members of Govt. organisation for their contributions to the *Journal* but it will be open to the Honorary Editor, to make payments for articles accepted from the outside public.

INSTRUCTIONS TO CONTRIBUTORS

Title—This should be brief, carefully chosen, and indicative of the contents of the article. It should be inserted on the top of the first page in block capitals.

Authors—The name of the author and his status should appear immediately under the title, but need not be entirely in capitals.

Introduction—An introduction presenting the general object of the work, and the scope and importance of the problem is, desirable.

Presentation—The matter should be neatly written, or typed double or treble spacing, on one side only of fullscape size paper with a left hand margin of 4 cm and margins of 2.5 cm at the top and bottom of each page except the opening page where the top margin should be 4 cm. The sending of the contributions in triplicate is recommended.

Summary—A condensed account of the important contents of the article should be at the end of article. The summary should be self-explanatory, complete and clear in itself, avoiding, as far as possible, technicalities.

Illustrations—The number of illustrations should be kept at a minimum as their reproduction is costly. Photographs and drawings should, if possible, be made to the correct proportion of the printed page of the magazine (20 cm by 15 cm). Nothing should be written in pencil or ink, or type-written on the back of illustrations as they cause trouble in reproduction. Photographs and illustrations should not be pinned or swen with thread as such pine holes reproduce in photography. The former should be in black and white, with pronounced contrasts and glossy finish; the later should be neatly drawn in Indian ink on white thick paper or drawing paper. Graph paper should preferably have black co-ordinate lineson white background. Captions should be typed or written on separate strips of paper and attached with colourless adhesives to the back of the prints. The approximate place where the illustrations are to be inserted should be indicate in the text, and the illustrations should be serialy numbered. In mailing illustrations should be placed between cardboards held together by thin thread or rubber bands.

Copyrighted pictures or photographs from commercial photographers should not be sent.

Punctuations—Authors should pay special attention to punctuation as this greatly aids the reader in understanding the author clearly; if this is left to the editor, a wrong punictuation made by him may alte the author's intended meaning of a sentence.

Citations—The Bibliography should be given at the end of the article on separate sheet of paper and should be typewritten double-spaced throughout. Reference to a citation in the text should be made by means of the author's name followed by a reference number in parentheses. In the bibliography the ctartion should be preceded by the reference number. The citation will consist of the serial number, the autho of name and initials (in large and small capitals), the year of publication, the title of the article, the title of the book, paper or periodical, volume number and date of issue and the page numbers, thus:

Hamilton, A.P.F., (1947). Farm Forestry in India. *Indian For.*, 74 (3), 84–88

Corrections—Authors are requested to see that their typescripts incorporate all corrections they desire to be carried out as no revisions are permitted by the press in the proof stage and any resetting involves heavy cost.

Capitals—Normally, typewritten or handwritten matter should show where capitals are to be used. If a whole wordor line has to be printed entirely in capitals the original should also be so written. To indicate italics a single straight line should be drawn under the matter concerned in the original text

For detailed instructions see the editorial in the *Indian Forester* of May, 1950

THE
INDIAN FORESTER

VOLUME 114 DECEMBER, 1988 NUMBER 1

A VIEW OF NATURAL MIXED FOREST, TEJAM, DISTT. PITHORAGARH (U.P). Photo—M.D. Dhoundiyal Front Cov

CONTENTS

ARTICLES

EUCALYPTUS EXPERIMENT—BRAZIL. S. Shyam Sunder 82

STUDIES ON THE EFFECT OF GROWTH HORMONES FOR VEGETATIVE PROPAGATION OF *WOODFORDIA FRUTICOSA* KURZ. BY ROOTING OF BRANCH CUTTINGS. V.K. Bahuguna, V.K. Dhawan and B.D. Pant 8

MODIFIED VOLUME TABLE FOR EUCALYPTS IN HARYANA. J K. Rawat 8

INSECT PESTS OF LEGUMINOUS FOREST TREE SEED AND THEIR CONTROL. Pratap Singh and R.S. Bhandari 8

A COMPARATIVE STUDY OF CCA TREATMENT OF TREE GUARD POLES OF *EUCALYPTUS* HYBRID BY SAP-DISPLACEMENT AND BOUCHERIE PROCESSES. S.N. Sharma, P.V. Krishna Rao and V.V. Srinivasan 8

WOOD STRUCTURE OF *CLETHRA MONOSTACHYA* REHDER AND WILSON. R.D. [illegible] and R. Dayal 8

AMENTOTAXUS (TAXACEAE)—A RARE GYMNOSPERM FROM ARUNACHAL PRADESH. K. Haridasan ... 8

ANATOMICAL FEATURES ASSOCIATED WITH THE PRODUCTION OF GUM IN *BAUHINIA RETUSA* HAM. S.P. Agrawal 8

SAND MINERALS IN THE SOILS OF SOUTH KHERI FORESTS, (U.P.) S.P. Banerjee, A.K. Raina and K C. Mathur ... ...

CHEMICAL CHARACTERISATION OF *OLEA DIOICA* ROXB. SEED OIL. P.P. Jain, N.P. Dobhal and K.S. Ayyar 8

ON THE BIOLOGY OF *STERCULIA URENS*, ROXB. (KULLU) DEFOLIATOR *OGLASA SEPARATA* WALKER (LEPIDOPTERA : NOCTUIDAE). H R. Khan, Lalji Prasad and Sushil Kumar ...

EFFECT OF MOISTURE STRESS ON SEED GERMINATION OF SPRUCE. Virendra Singh and G.S. Paliwal ... ...

RESEARCH NOTES ... ...

BOOK REVIEW ... ...

GAZETTE NOTIFICATIONS ... ...

FORM IV ... ...

CENTRAL EDITORIAL BOARD

R.V. SINGH, I.F.S. (*President*), G.P. MAITHANI, I.F.S. (*Hony. Editor*)
S.K. PANDE, I.F.S, RAMESH DAYAL

Edited by G.P. Maithani, I.F.S., Honorary Editor, Indian Forester (Director, Forest Rese Institute, Dehra Dun), Published by B.S. Beniwal, I.F.S., Business Manager, In Forester (Assistant Silviculturist (G), Silviculture Branch, Forest Research Institute, Dehra Dun) Printed by S.K. Arora at Print World, Dehra Dun.

Registered No. D.N. 36